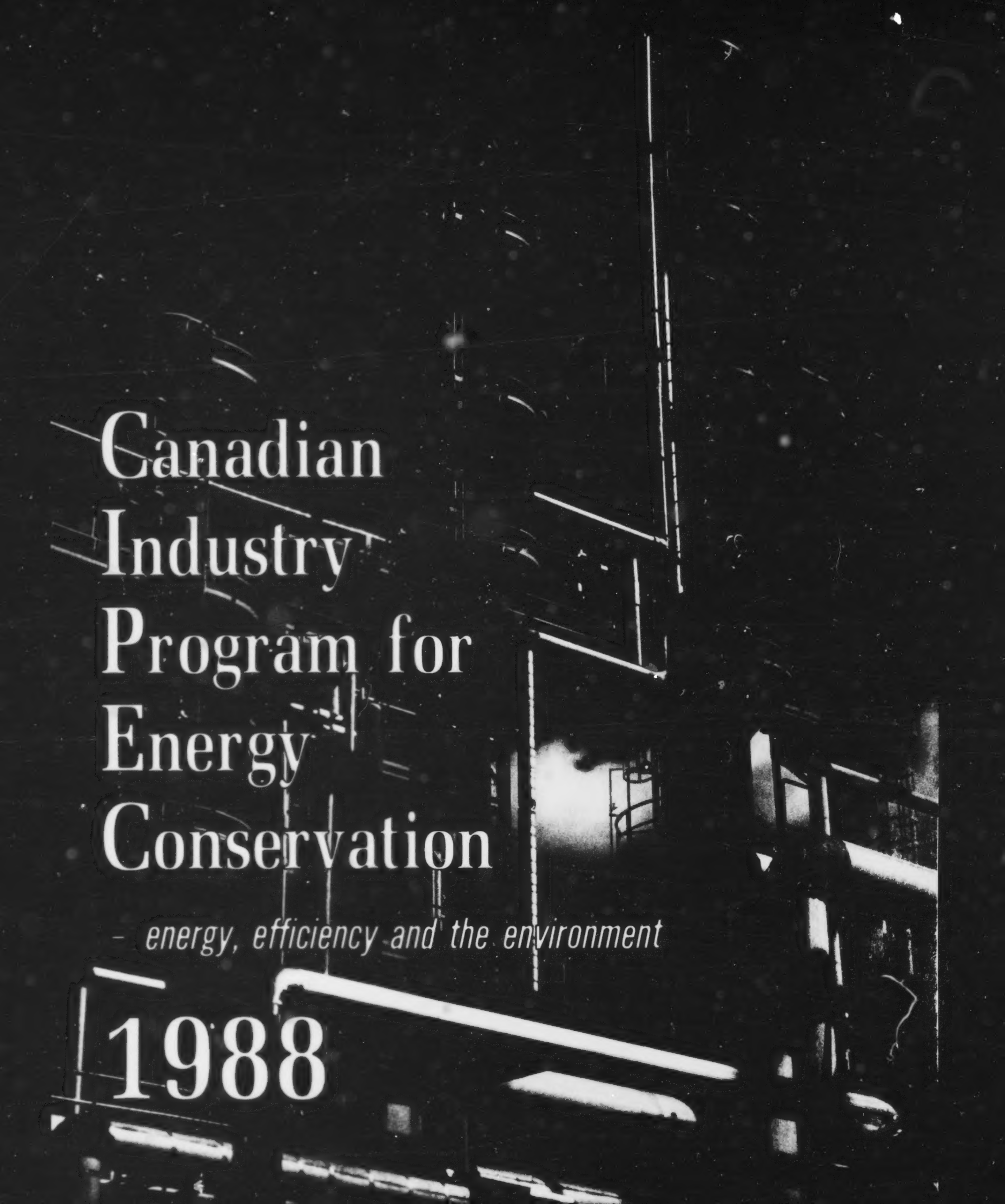

Canadian Industry Program for Energy Conservation

– *energy, efficiency and the environment*

1988

90-05736/

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Errata

Subsequent to publication of the 1988 CIPEC Annual Report, it was discovered that some errors had been made under the Transportation Industry (Mfg.) Section. In order to correct the errors, please add, amend or substitute as follows:

1. Please substitute the following on the inside covering page under the heading Transportation:

   Ian Hatcher
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2. Please substitute the last sentence of the first paragraph on Page 70 under the heading "Future Outlook and Concerns" as follows:

   "This will result in a significant improvement in our overall energy efficiency, and should put the Task Force within reach of its target of improving energy efficiency by 10% in 1990 compared to the 1985 base year."

3. Please substitute the last paragraph on page 70 under the heading "Future Outlook and Concerns" as follows:

   "The Task Force believes that energy management is an issue for the 1990's – in terms of the competitive position of our sector companies, and also in terms of the effect of energy use on the environment. The CIPEC Program continues to provide a vitally needed communication tool. CIPEC's vast industrial network coupled with government participation is a vital element needed to ensure our competitive position and improved protection of Canada's environment through effective energy management.

4. In the CIPEC Report "Reporting Companies" listing, under sub-sector "Transportation (Mfg.)," please amend Bombardier Inc. and Canadair Aeronautical & Defense Group as follows:

   Bombardier Inc., Groupes aeronautique et defense Canadair

5. Please add the following Table to the Transportation (Mfg.) sub-sector report.

Table III **Transportation Industry (Mfg.) Task Force**

Sector Performance
Percentage Improvement/Deficiency In Energy Efficiency Against Base Year

	Base Year 1985			Base Year 1978						
Subsector	**1988**	**1987**	**1986**	**1985**	**1984**	**1983**	**1982**	**1981**	**1980**	**1979**
ABAC (Boating)	0.0	–	–	–	12.9	3.1	- 48.5	- 88.1	–	- 0.7
AIAC (Aerospace)	2.8	5.2	5.2	20.6	7.9	7.3	3.9	- 43.7	6.0	- 1.2
APMA (Autoparts)	4.6	3.9	2.7	6.5	13.5	11.7	5.8	26.7	15.6	3.3
CMIA (Maritime)	1.9	15.2	- 19.4	11.4	- 2.9	10.6	- 21.1	46.8	- 14.1	- 9.0
CTTMA (Truck/Trailer)	- 0.2	9.0	–	- 26.3	- 15.4	- 56.9	- 65.2	- 25.6	- 18.1	- 0.02
MVMA (Motor Vehicles)	- 6.7	- 6.6	2.0	28.8	22.8	- 6.3	3.3	–	–	–
TASK FORCE (Performance to Base Year)	- 3.5%	- 3.3%	2.1%	25.6%	20.3%	1.2%	3.7%	3.2%	4.5%	0.4%
TASK FORCE GOAL	◄- - - + 10% by 1990			◄- - - + 25% from 1978 to 1985						

Errata

Subsequent to publication of the 1988 CIPEC Annual Report, it was discovered that some information should have been included under a different heading than was used initially.

Please substitute the company names listed on this page under the heading "Machinery" for those listed on page 78 of the report.

Please substitute the company names listed on this page under the heading "Mining and Metallurgy" for those listed on page 79 of the report.

Machinery

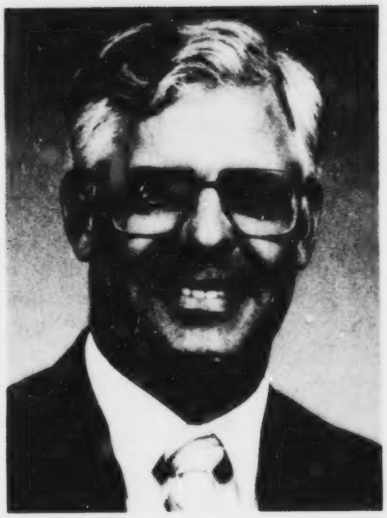
ACCO Canadian Material Handling, a Division of Babcock Ind. Canada Inc.
BEVCO Conveying Systems
Boart Canada Inc.
Canadian Blower/Canada Pumps Limited
Canron Inc.
Continuous Mining Systems Limited
Dominion Engineering Works Ltd.
Dresser Pump Division, Dresser Canada Inc.
Ecodyne Limited
FAG Bearings Ltd.
Gorman-Rupp of Canada Limited
Heath & Sherwood (1964) Limited
Hymac Ltd.
Industries USP Inc.
Ingersoll-Rand Canada Inc.
ITT Fluid Products Canada, Division of ITT Industries of Canada Ltd.
Jenkins Canada
H.G. Kalish Inc.
H.J. Langen & Sons Ltd.
M.A.N. Ashton Inc.
MacLean Engineering & Marketing Co. Ltd.
MTD Products Ltd.
Pullmaster Winch Corporation
RMS Machinery Division, Uniroyal Goodrich Canada Inc.
S.A. Armstrong Limited
Sanden Machine Limited
Smart Turner Limited
Sullivan Strong Scott, Division of Strong Equipment Corporation
Valmet-Enerdry Inc.
Ward Ironworks Limited
Webster Air Equipment, Division of Curtiss-Wright of Canada Inc.

Mining and Metallurgy

Cameco
Cominco Ltd.
Denison Mines Ltd.
Falconbridge Limited
Giant Yellowknife Mines Limited
Hudson Bay Mining and Smelting Co., Limited
Inco Limited
Iron Ore Company of Canada Ltd.
Noranda Minerals Inc.
Pioneer Metals Corporation
Placer Dome Inc.
Quebec Cartier Mining Company
Rio Algom Limited
Syncrude Canada Limited

CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE



W. Peter Torbet

November 29, 1989

The Honourable Jake Epp, P.C. M.P.
Minister, Energy, Mines and Resources
House of Commons
Ottawa, Ontario
K1A OA6

Dear Minister,

Progress towards our 1990 goal of a 31% improvement over 1973 energy intensity levels continued in 1988 with an additional 0.4% improvement over 1987. This raises the total improvement since 1973 to 28.8%. While this is less than last year's 2.6% improvement and an average of 1.8% per year for the program, it does reflect the level of incentives for investment in energy efficiency improvement in 1988.

As we review the past efforts of the CIPEC program and the current energy environment, the question that continues to be raised is: "What provides the incentive for investment in energy management measures?"

In the 70's, several factors played a role – a national imperative, forecast energy shortages, the spectre of government regulation and/or quotas. They led to the formation of the CIPEC program to provide an umbrella organization to represent Canadian Industry and provide a focus for reporting and information transfer. However, there was also very strong support from market forces – significantly higher energy costs for Canadian Industry. The net result was a 15.4% improvement in energy efficiency in 1980 vs. 1973.

In the 80's the scene changed. Government moved away from energy regulation. Significant additional energy sources were identified. There were additional priorities for industry – health and safety, North American and global competitiveness and quality. The market forces, ie. energy prices, became significantly less influential. While these all shifted the focus away from energy management investments, 1988 energy productivity was an additional 13.4% better than that of 1980.

What do the 90's hold? The incentives are largely unchanged from the 80's with the major factor, energy prices, a dis-incentive. Without additional incentives the strong progress of the 70's and 80's will not continue. There is, however, a larger issue that energy efficiency can help address – the environment. Every discussion and consideration of this issue recognized the vital contribution that improved energy efficiency can make. Our task is to present the need as the incentive to accelerate the energy management effort.

The past year has been difficult for the CIPEC program. The suspension of funding for a 4-month period and the elimination of the programs sector of EM&R from which technical and administrative support was provided has caused industry participants to re-assess their support of the program. We have concluded that the easy decision, but also the wrong one, would be to stop the effort. In addition, recent discussions with your officials have convinced us this was the right decision and that a revitalized task force network can help respond to an environmental agenda. We believe now, more than ever, the CIPEC program is vital to provide the incentive to obtain the environmental benefits that accrue from effective energy use.

We look forward to the renewed support of your ministry as we tackle the energy/environment challenge.

Yours sincerely,

W Peter Torbet

W.P. Torbet
Chairman, CIPEC Council

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives are to promote energy conservation by:

- Setting voluntary energy efficiency improvement goals;
- Reporting annually to government on issues and progress relative to achieving these goals;
- Increasing energy management awareness and techniques within industry;
- Exchanging non-proprietary energy information for common benefit;
- Maintaining effective industry-government dialogue.

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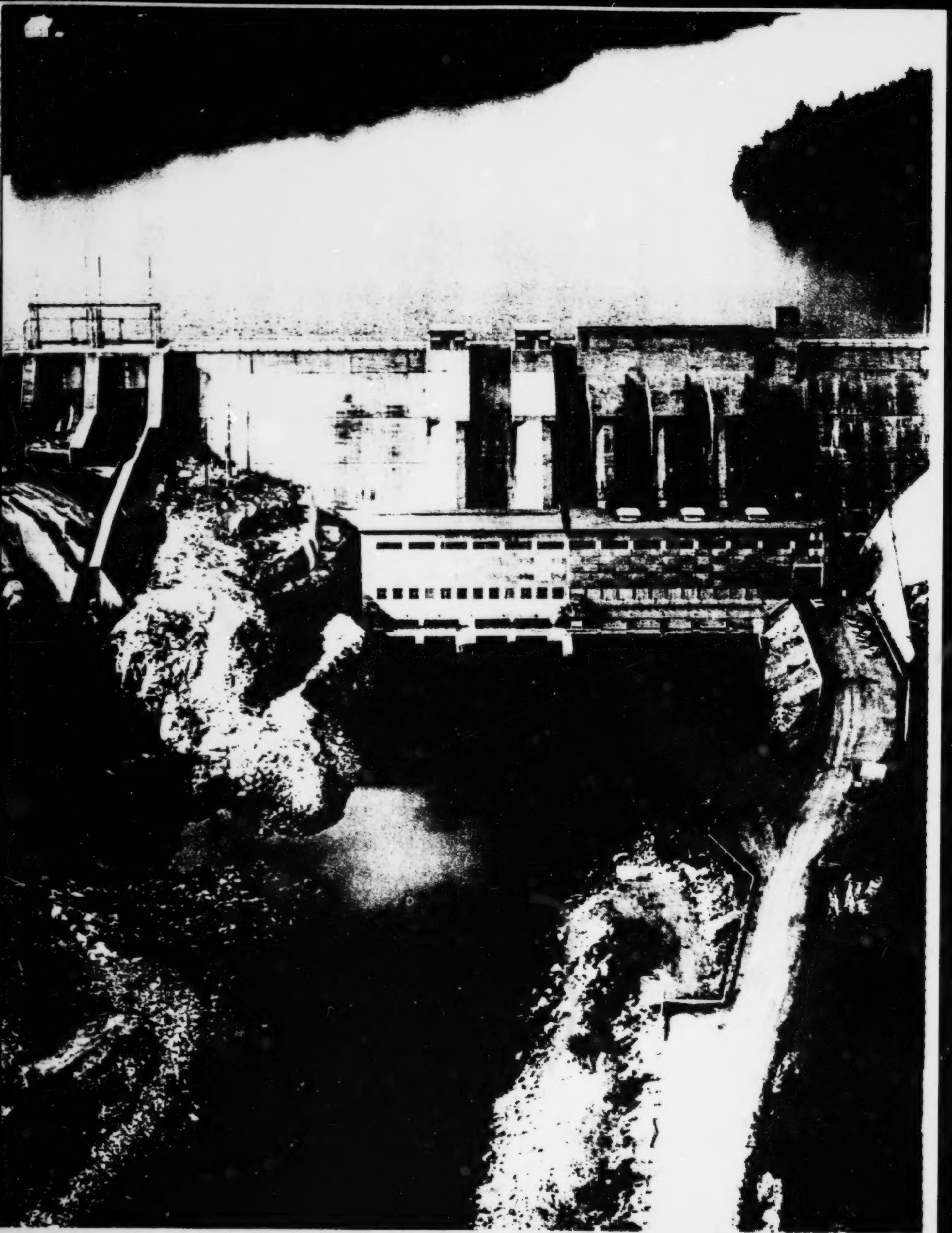


Energy Efficiency and the Environment

1988 PERFORMANCE

This year, 650 energy-conscious manufacturing and mining companies participated in the voluntary CIPEC survey. The energy used in these companies represents about 75% of the total consumption in the entire manufacturing and mining industries.

Energy consumption per unit of output in the surveyed companies remained relatively unchanged in 1988. The flat performance is the result of many interrelated factors, which affect each industry in different ways. In Figure 2, the performance of the 14 participating sectors is displayed together with their 1990 goals. Performance comparisons, however, should not be made between industries since each has vastly different energy intensities and potentials for energy conservation.

Energy efficiency, aggregated across all sectors, improved by 0.4%. The total improvement to date is 28.8% better than 1973 energy intensity rates and 4.7% above the new 1985 base year reference levels.

Figure 1

CIPEC Energy Improvement

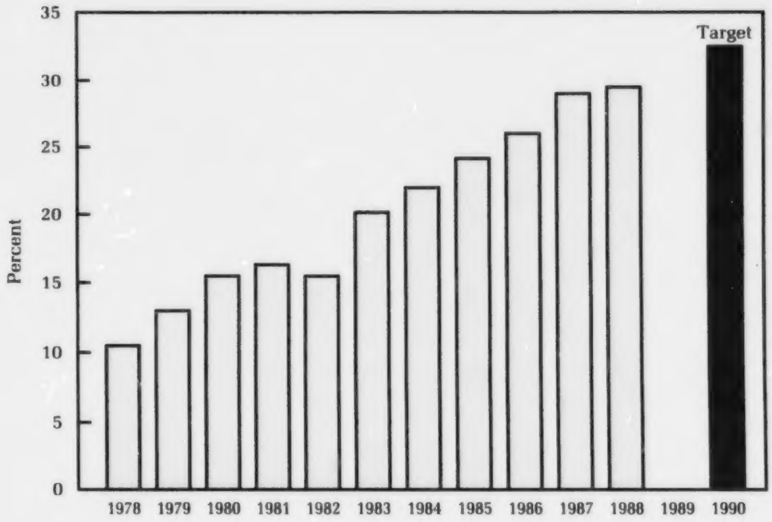
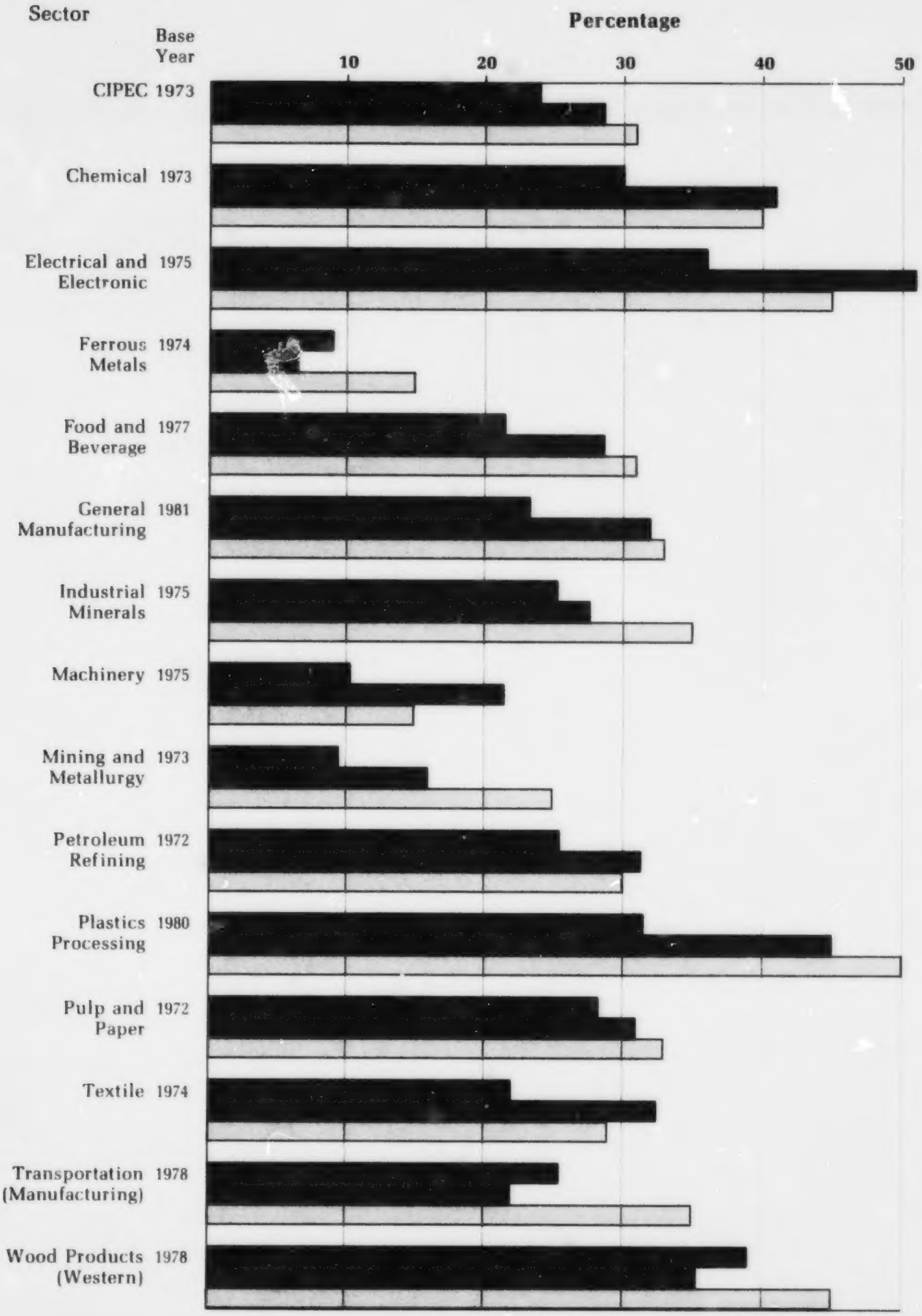


Photo – Ontario Hydro

Figure 2

ENERGY INTENSITY IMPROVEMENT



Sector	Base Year	1985	1988	1990
CIPEC	1973	24.1	28.8	31
Chemical	1973	30.0	41.1	40
Electrical and Electronic	1975	36.1	52.9	45
Ferrous Metals	1974	9.1	6.6	15
Food and Beverage	1977	21.5	28.7	31
General Manufacturing	1981	23.4	32.1	33
Industrial Minerals	1975	25.4	27.7	35
Machinery	1975	10.4	21.5	15
Mining and Metallurgy	1973	9.6	16.0	25
Petroleum Refining	1972	25.6	31.3	30
Plastics Processing	1980	31.5	45.0	50
Pulp and Paper	1972	28.3	31.1	33
Textile	1974	22.1	32.6	29
Transportation (Manufacturing)	1978	25.6	22.1	35
Wood Products (Western)	1978	38.9	35.2	45

Legend: ■ – 1985 Total Improvement
■ – 1988 Total Improvement
▨ – 1990 Goal

Source: CIPEC Task Force Reports

Table I

Industrial Economic Activity

(in current dollars)

Sector	GDP (Million) 1988	GDP (%) Chge.	Capacity Utilization (%) 1988	Capacity Utilization (%) Chge.	Cap. & Rep. Investment (Million) 1988	Cap. & Rep. Investment (%) Chge.
Chemicals	7,235	7.7	93.8	4.1	1,769	3.4
Electrical & Electronic	13,193	16.2	95.7	11.3	792	– 1.7
Ferrous Metals	8,574	10.7	77.5	3.2	3,233	7.4
Food & Beverages	11,928	6.1	79.9	– 7.5	1,968	9.4
General Manufacturing	2,697	5.5	68.7	– 5.2	324	– 13.6
Industrial Minerals	3,278	5.9	79.7	0.8	749	14.0
Machinery	4,473	14.8	81.7	6.9	526	23.8
Mining & Metallurgy	11,485	11.3	92.5	1.8	4,189	– 2.5
Petroleum Refining	1,155	9.7	84.0	2.3	1,088	5.1
Plastics Processing	2,026	6.4	92.7	– 3.8	668	9.8
Paper Industries	9,064	7.1	90.0	– 0.3	5,324	28.3
Textiles	2,703	5.7	94.6	– 1.7	396	2.8
Transportation (Manufacturing)	13,192	13.3	71.4	1.4	3,570	9.0
Wood Products (Western)	5,901	3.8	91.3	– 5.1	1,568	26.4
Durable Goods Industries	60,340	13.1	80.4	2.8	n.a.	n.a.
Non-Durable Goods	44,919	6.6	87.3	0.2	n.a.	n.a.
Total Manufacturing	105,259	10.3	83.6	1.4	29,308	16.1

Source: Statistics Canada Catalogues #15-001, #31-003, #61-205.

In a strong economy, management's attention is usually directed to the needs of production, and when coupled with high capacity situations, the urgency to expand facilities. This often results in a strategy of satisfying immediate needs first and concentrating on efficiencies at a later date. Moreover, the energy efficiency of many existing plants declines when production levels are pushed to their limit. Numerous examples of this were reported in 1988.

Eleven of the thirteen manufacturing sectors increased capital spending in 1988 while spending in the mining sector decreased. Table I shows that capital investment expenditures in the manufacturing industry rose 16.1% in nominal terms in 1988 compared to 1987 and the lion's share was spent on new machinery and equipment. But very little was directed to energy efficiency improvement projects.

Several participants indicated that energy improvements were included in capital projects only when savings provided about twice the normal economic return. New capital projects normally require 12% to 18% internal rates of return for approval (given the relatively high interest rates), but energy conservation projects often required 20% to 50% minimum return rates.

Several manufacturing sectors, including chemicals, food & beverages, plastics, paper industries, textiles and wood products, have been

Table II

Average $/GJ

Sector	
Chemicals	4.47
Electrical	6.80
Ferrous Metals	3.21
Food & Bev.	6.64
General Mfg.	6.54
Ind. Minerals	4.74
Machinery	7.47
Mining	7.20
Pet. Refining	2.92
Plastics Proc.	8.24
Pulp & Paper	7.67
Textiles	6.64
Trans. Mfg.	6.33
Wood Prod.	7.75
CIPEC Average	4.99

Table III

Average Industrial Energy Prices

Province	Type	$ / GJ 1988	Annual % Increase 1980 - 1988
Newfoundland	Electrical	15.53	8.3
	Oil	8.15	7.1
Prince Edward Island	Electrical	8.30	1.8
	Oil	8.10	7.2
Nova Scotia	Electrical	13.31	4.5
	Oil	7.36	6.7
New Brunswick	Electrical	11.78	3.9
	Oil	8.28	8.3
Quebec	Electrical	9.00	4.6
	Oil	7.36	6.5
	Natural Gas	4.52	7.0
Ontario	Electrical	12.47	7.8
	Oil	8.33	8.6
	Natural Gas	3.56	5.0
Manitoba	Electrical	8.30	5.1
	Oil	8.33	8.7
	Natural Gas	2.88	3.4
Saskatchewan	Electrical	15.67	9.4
	Oil	7.33	7.0
	Natural Gas	2.46	5.0
Alberta	Electrical	8.81	6.7
	Natural Gas	1.82	4.0
British Columbia	Electrical	8.75	8.7
	Oil	2.32	7.7
	Natural Gas	7.90	4.8
Canada	Electrical	10.78	6.8
	Oil	7.85	7.6
	Natural Gas	2.82	4.7

operating above 80% total capacity since 1985. These sectors are therefore more inclined to increase production capacity over the next few years. In fact, the last four have experienced small declines in utilization rates in 1988 as new additions to the capital stock came on stream.

According to Statistics Canada, the mining sector capital investment (in construction and repairs) has remained relatively flat despite real increases in its Gross Domestic Product. The rise in output was possible through greater use of existing operations, as indicated by a 2 point rise in capacity utilization to 92.5%.

Reduced equipment capital cost tax allowances (Class 34) and lengthened paybacks due to soft energy prices also had a negative impact on promoting energy efficiency projects.

Colder winter weather had a noticeable influence on higher energy demand and operating efficiency in 1988. The temperature during the first and last quarters was 5.9% and 7.5% colder than 1987 (based on degree-day data throughout the country). The amount of fuel required for space heating increased accordingly and contributed to record increases in demand for natural gas, electricity and coal.

Together with slow oil and natural gas price increases, the motivating factors to improve energy efficiency were weak in 1988. Average energy costs (Table II) vary considerably

Figure 3

Industrial Energy Cost Savings

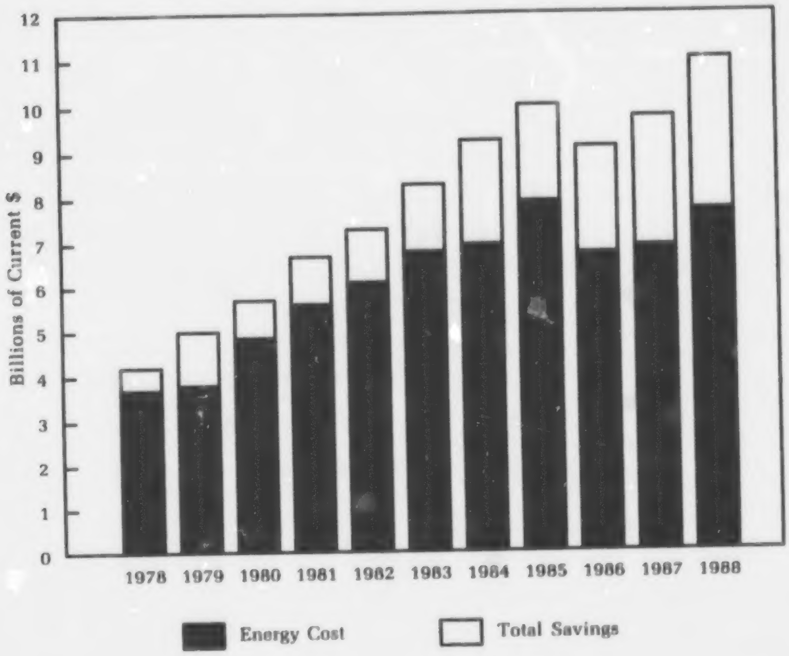


Figure 4

Distribution of Energy Costs

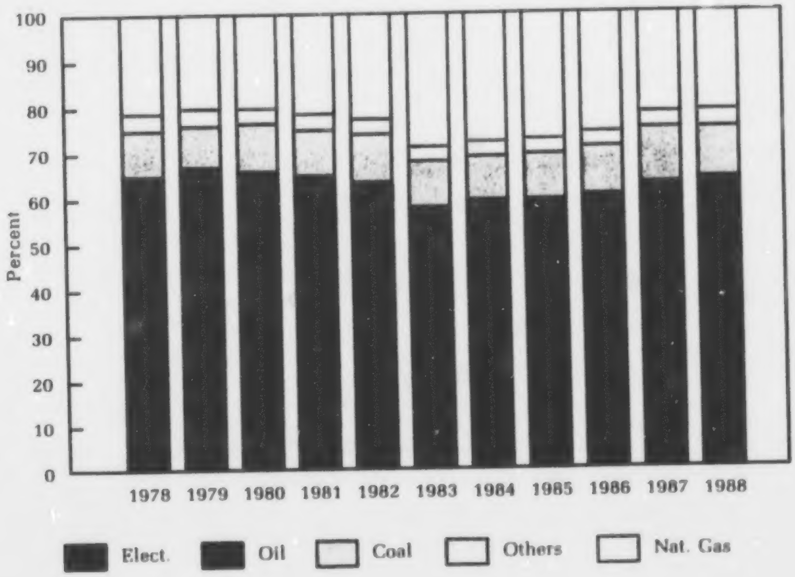


Table IV

1988 Energy Consumption, Costs, and Savings

	Energy Use[1] (PJ)	Estimated Total Cost ($,000)	Total Savings ($,000)	Incremental Savings ($,000)
Chemicals	309.89	1,384,645	968,193	21,371
Electrical & Electronic	6.28	43,175	48,589	(533)
Ferrous Metals	277.07	888,947	62,816	(12,273)
Food & Beverage	37.98	252,145	90,666	7,183
General Manufacturing	19.97	130,538	61,712	4,037
Industrial Minerals	91.47	433,500	166,500	2,836
Machinery	0.65	4,827	1,322	83
Mining & Metallurgy	135.26	973,727	185,607	37,515
Petroleum Refining	266.19	516,587	235,359	4,154
Plastics	2.67	21,993	17,978	1,292
Pulp & Paper	334.95	2,440,315	1,111,817	(43,149)
Textiles	8.24	54,733	26,471	3,493
Transportation	46.64	295,269	83,775	(584)
Wood Products	6.98	54,105	37,754	767
Total	1,544.25	7,494,506	3,098,561	26,194

(1) All sectors' electricity converted at 3600 kJ/kWh.
Numbers may not add due to rounding.

Source: CIPEC Database.

among the surveyed industries because of the different consumption patterns, use of waste materials and process technology. Average prices are also affected by the concentration of industries in certain provinces, as shown in Table III. As well, the amount of consumption also has a major impact on unit costs.

Electricity continues to be the most expensive source of energy – making it a significant target for increased energy management attention. If electrical prices continue to escalate at the same rate experienced in recent years, relative to other sources of energy, industrial energy managers will undoubtedly find the introduction of demand-side management programs useful in helping to reduce costs.

Energy Costs and Savings

Based on estimated fuel and electricity costs of $7.5 billion among the CIPEC participants, energy budgets would have been $26 million higher if the 0.4% energy efficiency improvement and the effects of substitutions had not occurred. Even though the 1988 efficiency gain was marginal, the increased level of manufacturing cost savings was significant.

Total cost savings for 1988, as shown in Figure 3, amount to some $3.1 billion based on the overall 28.8% efficiency improvement since the 1973 base year.

The estimated cumulative savings for the program now total $22.1 billion.

For the past eight years energy cost trends shown in Figure 4 indicate that electricity's share of total costs has steadily increased while the oil share has decreased. Electricity now provides 21% of the total energy, but comprises 54% of total expense.

The total cost savings shown in Table IV for each sector are based on their respective efficiency gains to date. The incremental costs reflect the cost increase or savings achieved during 1988, depending on the reported performances.

Energy Consumption and Trends

Manufacturing and mining companies used 32.7% of the total 6309 petajoule domestic secondary energy demand recorded for 1988. Primary production incudes all energy for export and quantities used by the supply industry itself for conversion and delivery of the amounts for secondary demand. The other major energy consuming sectors include transportation with 30% of the total, residential with 19% and commercial with 14%.

Since CIPEC monitoring began in 1978, all manufacturing and mining's energy consumption has grown by 23% (from 1,844 PJ to 2,067 PJ), mostly due to a 32% increase in production. Using the CIPEC method of calculating energy efficiency, all industry has experienced a 15% improvement since 1978. During this period, the energy consumption reported by CIPEC participants has been marginally reduced from 1,575 PJ to 1,544 PJ while their production has increased 20%. CIPEC's efficiency improvement of 18.1% since 1978 demonstrates that its participants are improving at a somewhat faster rate than non-participants.

Table VI, Distribution of Energy Consumption, presents the historical data on energy shares of total consumption for selected years. This table shows that the use of petroleum products has fallen in CIPEC participating companies, while energy from all other sources has risen. Factors contributing to these shifts include price changes and incentives, availability, technology, and certain physical qualities that may provide new benefits.

Natural Gas

The natural gas share of total consumption in CIPEC companies has remained almost the same at 35.8% since 1983. Deregulation in 1985 didn't appear to have as much effect on participants' volumes as on costs, which fell by about 20%.

In the 5 years prior to introduction of deregulated gas markets in 1985, CIPEC surveys revealed only a minor direct response to the federal government's "off-oil" incentives. Most CIPEC companies were already using natural gas as their most economical fuel. Many companies now alternate with spot purchased oil to further minimize costs.

According to EMR statistics, domestic sales accounted for 45.7% of the 115.3 billion m^3 net production while exports accounted for 31.2%. Some 12.2% of domestic use was converted into liquid petroleum gases while producers used 9.4% themselves. Domestic demand rose 9% in 1988 as a result of higher space-heating demand, increased consumption by the transportation and pipelines sectors, and greater use of natural gas by utilities for generating thermal electricity. This rising domestic demand, coupled with increasing activity in the U.S. to acquire more Canadian supplies will probably result in upward pressure on prices.

Any further significant shift to greater use of natural gas in industry will require new policies that will promote development and installation of certain technologies such as natural gas-powered refrigeration systems and cogeneration. This is just beginning to occur in some locations through utility DSM programs. Greater use of these technologies helps dampen growing electricity demand.

Refined Petroleum Products

The CIPEC participants' consumption of fuel oil appears to have bottomed out in the 11% range. The mining industry's fuel oil consumption has decreased substantially over the past few years, in large measure due to the use of large quantities of off-gases as fuel in a major

Table V

Domestic Primary and Secondary Energy Consumption (PJ) Showing Manufacturing and Mining Sector Use

Type	Primary Production	Secondary Demand [1]	Total Ind. Demand	CIPEC Demand	CIPEC (%)
Electricity [2]	1,377	1,525	675	461	68
Natural Gas	3,921	1,883	857	590	69
Natural Gas Liquids	371	95	26	10	38
Oil Products	3,878	2,559	267	223	83
Coal & Coke [3]	1,614	230	227	241	–
Steam [4]	13	16	16	14	87
Others	–	–	–	58	–
Totals	11,175	6,309	2,067	1,597	77

Source: Statistics Canada Cat. #57-003, CIPEC Database.
"See footnotes at end of this chapter."

Table VI

Distribution of Energy Consumption (percentage)

	Electricity [1]				Natural Gas				Liquid Pet. Products				Coal & Coke				Others [(2)]			
	'88	'85	'80	'78	'88	'85	'80	'75	'88	'85	'80	'75	'88	'85	'80	'75	'88	'85	'80	'75
Chemicals	12.0	27.9	24.2	17.3	60.7	51.2	54.4	57.1	5.6	4.3	14.1	24.3	0.4	0.1	2.3	–	21.3	16.5	5.0	1.3
Electrical & Elect.	36.6	33.5	31.5	27.8	57.5	63.6	57.3	48.0	3.0	1.4	9.6	24.4	–	–	–	–	2.9	1.5	–	0.2
Ferrous Metals	8.0	7.3	5.9	5.4	20.4	19.4	18.9	15.4	5.8	4.2	10.5	13.2	65.8	69.1	64.6	68.6	–	–	–	0.3
Food & Beverage	21.8	18.6	14.6	12.8	66.6	69.7	64.8	48.5	11.3	11.7	20.6	38.5	–	–	–	–	0.3	–	–	0.2
General Mfg.	33.5	28.1	26.1	n/a	49.9	60.2	52.9	n/a	9.9	11.6	21.0	n/a	–	–	–	–	6.7	0.1	–	n/a
Industrial Minerals	16.6	15.6	15.8	10.3	38.9	42.6	43.1	50.6	7.5	8.7	26.1	33.1	36.1	32.4	14.3	5.8	0.9	0.7	0.1	0.1
Machinery	38.8	37.4	24.7	23.6	52.6	54.1	41.1	22.1	8.6	8.5	30.3	51.4	–	–	–	–	–	–	1.3	–
Mining & Metallurgy	34.5	41.2	39.5	35.1	40.5	25.2	18.6	12.4	16.2	23.5	36.5	48.0	8.6	9.9	4.5	4.4	0.2	0.2	0.5	–
Petroleum Refining	14.1	4.6	3.6	3.5	16.3	24.3	12.9	12.5	6.3	6.7	23.7	22.9	20.1	19.6	15.1	16.7	43.2	44.7	44.7	44.4
Plastics Processing	50.9	43.2	33.4	23.7	44.2	51.4	63.5	43.5	4.9	5.4	3.1	31.9	–	–	–	–	–	–	–	–
Pulp & Paper	47.9	44.9	29.1	24.9	26.7	26.1	25.5	18.3	23.4	25.8	41.3	52.7	1.5	2.9	3.0	3.6	0.5	0.3	1.0	0.3
Textiles	35.1	29.1	22.0	20.1	54.9	55.0	27.2	29.1	9.9	15.8	49.1	49.9	–	–	–	–	0.1	0.1	1.7	0.9
Transportation (Mfg.)	31.5	30.1	23.6	23.0	57.9	55.2	49.5	42.1	3.5	3.7	16.2	31.0	7.1	11.0	11.1	3.1	–	0.6	–	0.4
Wood Products	47.0	48.0	43.6	n/a	53.0	52.0	45.3	n/a	–	–	11.1	n/a	–	–	–	–	–	–	–	–
Totals	22.8	19.1	18.5	14.6	34.9	32.3	31.0	27.9	10.6	17.6	24.3	32.0	19.0	19.2	17.1	17.8	12.7	11.8	9.1	7.7

Footnotes:

(1) All sectors' electricity converted at 3,600 kiloJoules/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC Task Force Reports.

oil sands processor.

Compared to 1987 and 1986, many of the manufacturing sectors show marginal increases thought to be the result of lower oil prices. Unfortunately for the environment, much of this oil has a high sulphur content that contributes to acid rain.

EMR statistics indicate domestic demand for petroleum[5] from all sectors of the economy increased 5.4% in 1988 from 248.9 to 262.4 thousand m^3/day. High peaks in electrical demand force utilities to bring thermal generating stations on-line. Thus, fourth quarter domestic demand and imports of heavy fuel oil were higher than in previous quarters. Similarly, the bulk of the diesel fuel increase of 5.5% is attributed to the high rate of activity in the mining sector during 1988.

Since world oil prices are expected to remain somewhat the same well into the 1990's, and gas costs are expected to accelerate because of increasing demand, some movement back to oil should be expected.

Electricity

Demand for electricity in the surveyed companies continues to grow by about 1% per year. CIPEC electrical growth is somewhat lower than the total industry increase of 4%, which includes several thousand small and diverse firms that are generally too small to practice organized energy conservation. By comparison, residential electricity consumption increased by 5.8% and the commercial sector's demand rose 7.5%. Electricity now provides 20.9% of the total reported power but accounts for about 54% of the total energy cost.

The general shift towards greater use of electricity continues in nearly all surveyed industries. The trend seems to be greatest, as shown in Table III, in those industries that are more manufacturers than extractors and processors of natural resources. The apparent drop in the chemical industry is due to large scale increases in petrochemical operations which are major gas consumers.

In different industries, shifting consumption patterns occur for many reasons. The general reason, however, includes application of new electro-technologies, emphasis on fuel conservation and recovery of wastes, response to oil substitution incentives, impact of deregulated gas markets, etc.

For example, in Quebec, where 75% of total power is generated from hydro sources, overall demand increased because of the attractive steam boiler conversion incentives provided by Hydro Quebec 5 years ago. Many end-users, especially in the pulp & paper and textile industries, switched back to oil in 1988 when the difference between oil and electrical prices increased.

Coal and Coke

Domestic demand for coal increased by 8.5%, from 50.1 megatonnes to 54.4 megatonnes, due again to higher rates of thermal electricity generation.

Coal is used primarily in Ontario by utilities and by the steel and cement manufacturing industries. The cement manufacturing sector continues to use large quantities of coal but has, in some instances, switched to discounted natural gas. The largest cement manufacturer is continuing its investigation into cheaper sources such as municipal refuse.

Lime injection scrubbing systems, slagging combustors, irradiation cleanup methods, and fluidized bed combustion systems can all contribute to lower sulphur dioxide emissions in coal-burning processes. Unfortunately, these environmental safeguards often result in increased energy consumption, which exacerbates the economics of retrofit projects.

Other Fuels

The "other" category includes a diverse mix of wastes, process by-products and miscellaneous fuels used mainly by the chemical and petroleum refining industries. The huge amount of hog-fuel and pulping liquor used in the pulp and paper industry, as well as large quantities of hog-fuel used in the wood product industry are not included in this category because of the difficulty measuring heat content and quantities.

Occasionally, the use of these "wastes" changes when their resale value exceeds their replacement fuel value. A recent example of this phenomenon is the increased sales of by-product hydrogen.

Since many of these fuels are generally free sources of energy, industry has currently fully utilized this option. Constraints on greater use of waste fuels are the availability of steady supplies and technological problems associated with materials handling and combustion.

Energy and the Environment

Since the start of the industrial revolution, increasing consumption of fossil fuels has accelerated the release of the so-called "greenhouse gases" into the environment. Scientists have studied the extent of damage caused by these gases and predict that serious consequences will arise if drastic actions are not taken soon.

Industry is a major contributor to this problem. But industry also has the capability to take remedial action through energy conservation efforts.

Last year's annual report theme – ENERGY AT THE CROSSROADS – implied that the importance of energy conservation has reached a minimum level. Now, energy conservation has taken on a new dimension in this era of ecological responsibility.

Industrial energy conservation is no longer just a means of reducing operating costs for competitive reasons, but also a major way to help improve the environment.

In recent times there have been considerable increases in the emission rate and concentration of the so-called greenhouse gases (carbon dioxide, methane, chlorofluorocarbons, nitrous oxide and ozone) into the atmosphere. In the past ten years, the global average annual increase in atmospheric CO_2 concentration alone has risen significantly from about 315 ppmv to 350 ppmv. Scientists now believe the safe limit is well below 500 ppmv. The carbon dioxide gases are an environmental hazard because they trap the reradiation of ultraviolet rays which cause the global warming phenomenon. Other greenhouse gases combine with atmospheric moisture to form acid rain. It is also known that chlorofluorocarbons (CFCs) are destroying the earth's protective ozone layer.

The significance of the gas buildup in the atmosphere is enormous. Apart from the global damage that will become more evident as time passes, electric utilities are already starting to see the impact of the warming trend. It has been estimated by the Electric Power Research Institute (EPRI) that an average global temperature rise of less than 1°C over the next 25 years may cause local increases in peak power requirements by 10 to 20% beyond normal growth patterns in some locations such as North America where significant air conditioning and refrigeration equipment is used."

Carbon dioxide is thought to be responsible for about half the projected global warming[7] with N_2O adding an extra 8% to the greenhouse effect. Moreover, it is also thought that about one half the natural and man-made (anthropogenic) emitted CO_2 is retained in the atmosphere (the other half being absorbed into the oceans and plant life).

For global preventative measures to have any effect, new emission standards will need to be adopted on an international scale. However, it is clear that the environmental impact is not, and will not be distributed equally. For this reason, agreeing on emissions limitation will prove difficult. For example, if the aim were to limit global emissions to current levels but allow developing nations to expand their economies to feed their growing populations, this situation would require a massive reduction from the already highly industrialized countries.

To this end, the Soviet Union and the United States have already taken major positions of leadership in R&D and reduction of greenhouse gases. These two countries transfer 45% of the total quantity of carbon into the atmosphere from fossil fuel each year[8]. In 1985, the Soviet Union emitted approximately 1.0 billion tonnes while the U.S. added about 1.3 billion tonnes from industrial processes, electric power generation and transportation in about equal proportions. Accordingly, the Soviets and Americans have decided to collaborate on efforts to look at energy use and its impact on the environment in a totally new way. Their "end-use approach" now intends to focus more effort on certain key areas by:

1. Improving performance of electric generation systems and devices;
2. Developing advanced integrated energy technologies;
3. Setting new building construction standards mindful of the growing need for better indoor air quality;
4. Improving industrial energy efficiency;
5. Incorporating energy conservation into strategic macroeconomic planning;
6. Promoting renewable energy sources;
7. Adopting least-cost energy planning.

This overall plan could well serve as the priority for actions in other industrialized nations. The U.S. National Energy Policy Act of 1988 has already led to a flurry of political activity in which a number of bills to establish strategies and goals cover the following:

- Imposition of CO_2 emission standards on power plants
- Legislation of national goals for reducing CO_2 emissions by
  - 20% in 2000
  - 50% in 2015
- Promotion of energy efficiency
- Research and development of non-fossil fuel energy sources
- Expediting approval of new natural gas pipelines

Comparable actions that affect industry are being initiated in Canada. For instance, the federal government, through its 1988 ENERGY OPTIONS study began to look at various options and their impact on the whole economy. Subsequent task force studies on electricity conservation and acid rain in Ontario[9], for example, and ministerial meetings to discuss possible CO_2 reduction targets show some progress in this field.

There are several mitigating strategies to control and/or retard

Table VII

Canadian Industrial Greenhouse Gas Emissions
Reductions due to Energy Conservation and Substitutions
(tonnes X 10^3)

	Estimated Emissions[12]		No changes in efficiency or 1980 fuel mix[13]	Reductions due to		Net Reduction
	1980	1988		Energy Mix[14]	Effic.[15]	
CO_2	37,146	55,853	56,864	(9,468)	10,478	1,010
SO_2	749	539	1,147	507	101	608
NOx	213	244	326	36	46	82
CO	34	49	52	(6)	9	3
CxHy	13	6	20	13	1	14
Totals	38,156	56,692	58,409	(8,918)	10,635	1,717

"See footnotes at end of this chapter."

the build up of CO_2 in the atmosphere. Massive reforestation is one technique proposed by several responsible groups. It has been estimated[10] that to absorb 5 billion tons of global carbon emitted CO_2 every year from fossil fuel combustion would require planting 7 million square kilometres of trees – an area the size of Australia. Enhanced energy conservation can also result in significant reductions.

Since the energy producing sector itself is a major contributor to the emission of greenhouse gases, industry's efficiency in using electricity, for example, has an important indirect impact. Based on the total electricity and fossil fuel used by Canadian industry, it is estimated[11] the differences between the emission of greenhouse gases in 1980 and 1988, shown below in Table VII, and the amount that would have occurred had there been no energy efficiency improvement (as reported by CIPEC) provide significant environmental as well as economic benefits.

This study found that 66% of the 56 million tonnes of greenhouse gases emitted were caused by generating electricity with fossil fuels. According to Keepin and others[16], carbon laden gases released from conventional generating plants fired with coal, oil and natural gas is 0.75, 0.62 and 0.43 Gt/TWy, respectively. Combustion flue gases usually contain 12-15% carbon dioxide.

Of the total 489 teraWatt-hrs of electricity generated in Canada in 1988[17], 461.3 tWh went to final domestic consumption. Manufacturing and mining used about 42% of this available amount. Nearly 62% was generated from non-polluting hydro sources (mainly in Quebec, British Columbia and Newfoundland), while 16% was nuclear generated at about 50% efficiency. Conventional thermal plants, operating in the 30% efficiency range, generated 22% of the total power. Distribution losses amount to about 5% of the total power generated.

In generating electricity from fossil fuels, the energy conversion ratio is about 5 to 1. This ratio includes all losses from combustion, equipment losses, distribution losses, etc. For every kilowatt-hour reduction at the point of end-use, some 0.6 kg (1.2 lbs) of coal, or 0.5 liters (0.10 gallons) of light fuel oil, or 0.48 m^3 of natural gas is not used by the generating utility. As well, for every kilowatt-hour reduction, over 2 pounds of CO_2 emitted from a pulverized coal station (equipped with scrubbers), 1.6 pounds from a conventional oil fired station, or 1.1 pounds from a natural gas fired station is avoided. Clearly, more energy management attention should be directed to limit the growth of electricity consumption in the future.

Demand Side Management Programs

Another important new development appearing on the industrial energy management scene is the "Demand-Side Management" (DSM) programs being offered by various electrical utilities throughout the country.

High load growth over the last few years has been rapidly eating up reserve capacity. As well, new emphasis on "least-cost" strategies has led to formation of DSM programs which postpone the requirement for expensive new facilities. The essential techniques in DSM programs include peak clipping, valley filling, load shifting, and strategic conservation (increased efficiencies, cogeneration, small hydro generation).

Now that the environment has also become a major issue, the priority of traditional DSM programs is being turned around to place more emphasis on strategic conservation actions which offer distinct environmental benefits.

The mix of appropriate techniques and incentives, however, varies in each sector (industrial, commercial and residential) because of the different load patterns and potential for conservation. The level of these incentives is often a subject of intense debate.

For example, the Ontario Ministry of Energy in its review of Ontario Hydro's Draft Demand/Supply Planning Strategy suggested that "Ontario Hydro should not *a priori* rule out paying incentives up to full cost of the demand reduction measure for some programs" (p.iv). Later, in Ontario Hydro's annual rate hearing, the Ontario Energy Board heard evidence that, "Hydro's plan appears to reflect an approximate average (incentive) cost of $400-$500/kW of load reduction and shifting in the 1989-1993 period. This figure is well below the utility average avoided cost associated with demand management measures which, according to Hydro's own assessment, is about $1,000/kW, with individual measures valued at up to $3,000/kW" (p.269).

Undoubtedly all utilities are developing plans according to means and strategies deemed most appropriate in their respective areas.[18]

Energy Efficiency and the Environment – Footnotes

[1] Fuel and electricity consumption figures may not correspond exactly due to difference in supply-side and end-use accounting practices, different treatment of miscellaneous energy, feedstocks and wastes, as well as non-participation of small companies in CIPEC.

[2] Net 3600 kJ/kWh electrical conversion rate used. Secondary demand includes electricity generated from fossil fuels, but omits conversion and transmission losses integral to the generating system. Producer consumption and non-energy uses of fuel are also not included.

[3] CIPEC accounts for much of the coal used in the steel industry as fuel. From the total coal available, manufacturing used 1.4 TJ and utilities used 954 TJ to generate electricity. 182 TJ were used to manufacture coke for general use.

[4] Some CIPEC participants sell steam generated from processes and cogeneration.

[5] Petroleum is defined as crude and equivalent plus gas-plant ethane, propane and butanes.

[6] "The Politics of Climate", EPRI Journal, Electric Power Research Institute, June 1988, Pg. 14.

[7] Global Greenhouse Warming: Role of the Power Generation Sector and Mitigation Strategies, Ian M. Torrens (Director Environmental Control Systems), EPRI, Palo Alto.

[8] Policy Options for Stabilizing Global Climate, ed., D.A. Lashof and D.A. Terpak, Draft Report to Congress, U.S. Environmental Protection Agency, Feb. 1989, P. 11-14.

[9] Electricity Conservation and Acid Raid in Ontario, a study by Marbek Resource Consultants Ltd. for the Ontario Ministry of Energy, March 1989.

[10] "The Prospect of Solving the CO_2 Problem Through Global Reforestation.", G. Marland, U.S. Dept. of Energy, Report M.DOE/Nbb-0082, Feb. 1988.

[11] Greenhouse gas estimates prepared by Enertec Consulting Ltd. for the CIPEC report. Methodology available upon request.

[12] Emission factors from Erwin Ponitz, Energieverwertungsagentur (Austria), 1984; M.J. Grubb, paper in IEA/OECD Expert Seminar on Energy Technologies for Reducing Emissions of Greenhouse Gases (Proceedings), Paris, 1989, Vol I, P. 554; and Dr. R.L. San Martin (DOE), Proceedings for the same expert seminar, Vol I, P. 260.

[13] Emissions that would have occurred had there not been any efficiency improvements or changes in energy mix since 1980.

[14] An increase of 8.9 million tonnes of gases occurred due to increased fosil fuel consumption and additional consumption of electricity. Thermal generating stations consume as much as three times the amount of energy they produce due to conversion efficiencies of about 30% and other distribution and transmission losses.

[15] Aggregate industrial efficiency improved 15.5% between 1980 and 1988, based on CIPEC efficiency performance data.

[16] "Emission of CO_2 Into The Atmosphere", W. Keepin, I. Mintzer, and L. Krisoferson, SCOPE 29, Chilchester, UK. (John Wiley and Son) 1986, p 35-91.

[17] Statistics Canada Catalogue # 57-003.

[18] For details of DSM programs in each province contact: EMR, Planning, Analysis and Legislation Branch, 580 Booth Street, Ottawa K1A OE4, and request the publication Demand Side Management in Canada.

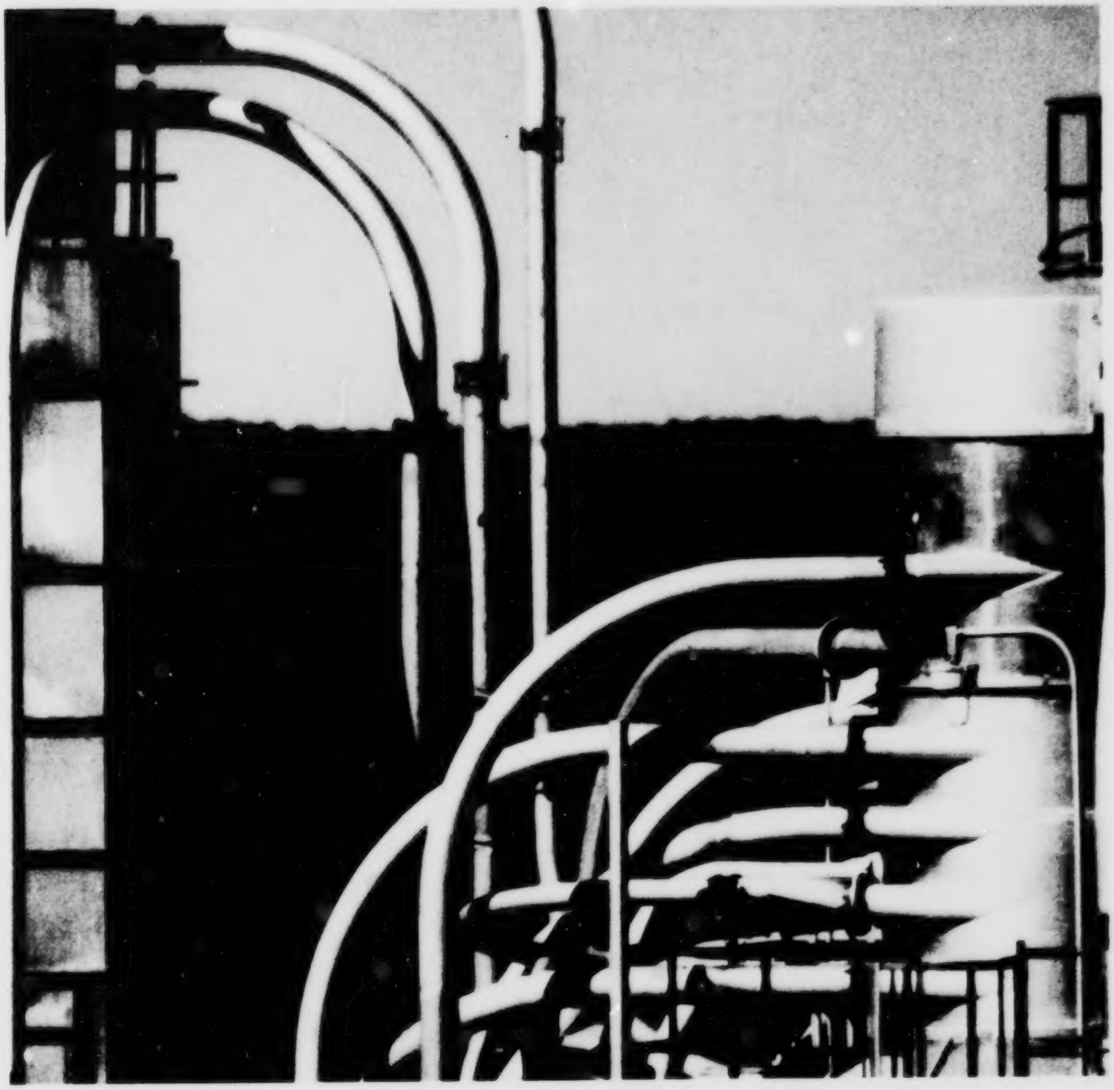
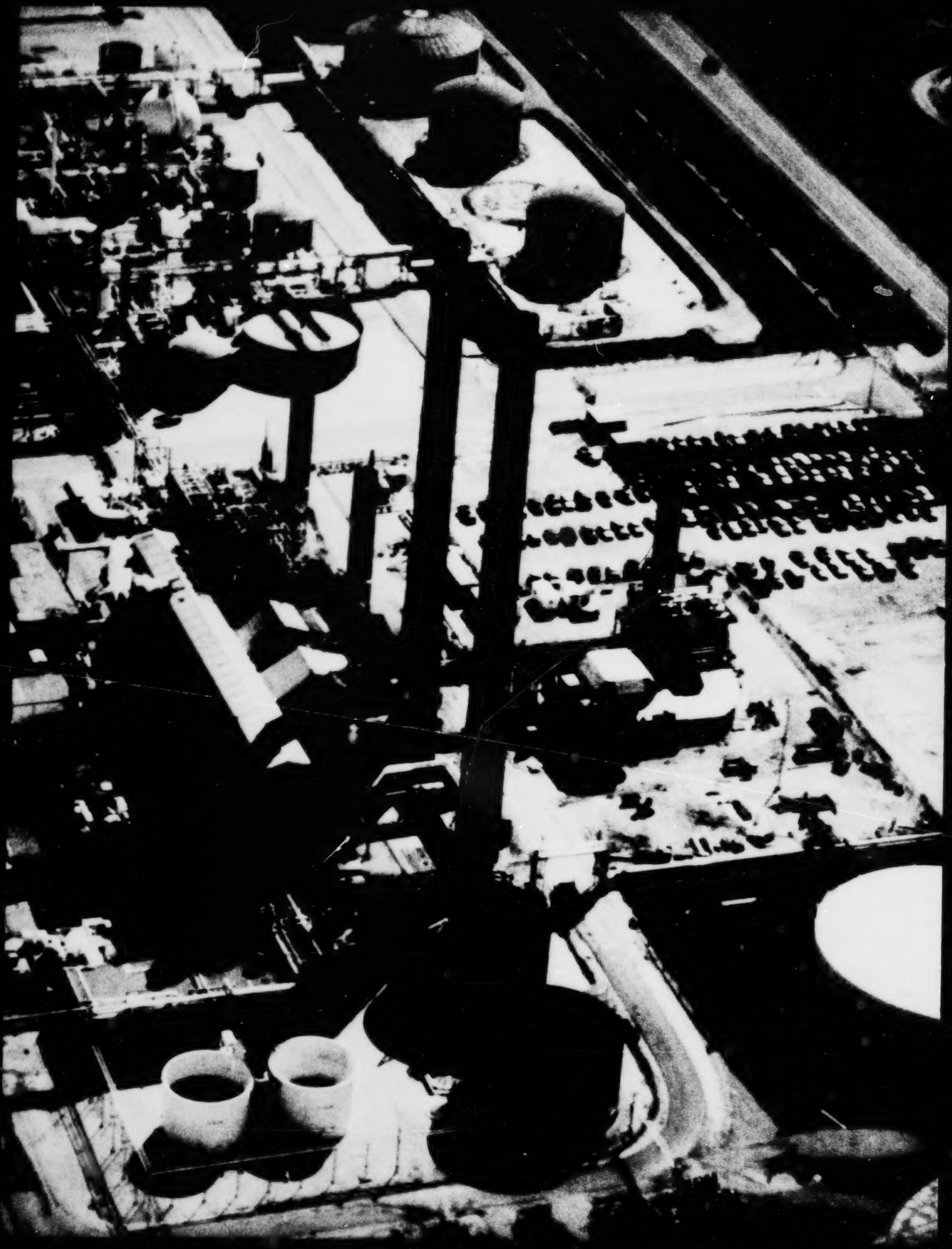
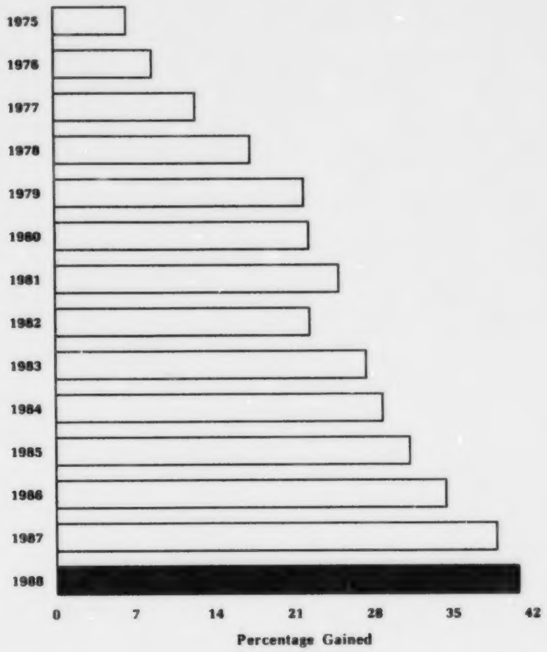


Photo – Maitland Plant
DuPont Canada Inc.





Chemical Industry

Energy Conservation Task Force

Dr. David Shearing
Chairman

General Overview

Energy usage and conservation in the chemical industry is monitored through an annual survey of member companies of The Canadian Chemical Producers' Association (CCPA). These companies produce a broad range of petrochemicals, inorganic chemicals and organic and specialty chemicals for domestic and export markets. Plant sizes vary from large-scale integrated facilities to smaller units that produce for particular markets.

This survey covers a range of companies including those spending less than $100,000 for fuel and electricity to those spending over $200 million on energy and feedstock. It is estimated that these corporations account for 85% of the total chemical sector's energy requirements, which in turn constitutes about 14% of the energy usage of the Canadian manufacturing industry. The survey figures exclude all forms of feedstock.

1988 PERFORMANCE

The surveyed companies improved their energy per unit of production by 1.5% during 1988. Aggregate energy-intensity has been lowered to 11.1% compared to the new 1985 base year levels and 41.1% compared to the aggregate 1972 reference year levels.

As a result, the industry has not only surpassed its 1990 improvement target of 40% set in 1985, but has also added $21.3 million efficiency related cost savings to the accumulated amount which now totals about $968 million since 1972.

Factors Affecting 1988 Performance

Excellent business conditions prevailed throughout 1988 which had a beneficial effect on energy performance.

Capacity utilization increased 4 percentage points to a high of 93%, according to Statistics Canada. High capacity utilization can have different effects on chemical processors. While many electrochemical processes operate most energy efficiently at top capacity, many of the petrochemical and organic processes are designed to peak at two-thirds to three-quarters capacity. Some references to sluggish energy efficiencies from some petrochemical operations at top capacities were noted in this year's survey.

Examples of Technological Improvements

In addition to the general economic factors that helped performance, there were many diverse technological improvements that are worth reviewing to demonstrate how the emphasis of various conservation programs have changed since monitoring began.

For example, in 1975 energy committee actions, HVAC improvements, upgraded insulation, attention to combustion efficiencies and housekeeping actions were reported as the initial focus of organized attention.

By 1980, reports of retrofits based on updated technical audits, switching to digital instrumentation, additional heat recovery and more sophisticated performance monitor-

Photo – Power House and Co-Generating Unit
Dow Chemical Canada Inc.

ing on desk-top computers were made on many questionnaires.

In 1983 and 1984, fuel substitution projects constituted the main effort. There were also renewed efforts to improve combustion efficiencies to dynamically balance steam systems, accelerate changes in process technologies and debottleneck operations.

By 1985, pinch technology studies of heat exchange systems and computerized simulation analysis were being used as the basis for process optimization. Installation of electric boilers in Quebec was frequently mentioned as a result of attractive Hydro Quebec marketing incentives. Deregulation of natural gas markets set off a whole new wave of technical and management solutions including better techniques to schedule production.

In 1988, many large "direct customer" plants in Ontario were introduced to Time of Use (TOU) electric rate structures. One company found it advantageous to replace its electric boilers with new equipment fired by natural gas. Another new development is the fact that companies are starting to go after low-grade sources of waste heat.

As usual, a great variety of projects with excellent savings were again reported in this year's survey. For example, enclosing a shipping dock at a cost of $40,000 is expected to save $100,000 per year. Installation of a $40,000 furnace air preheater system will provide savings of some $31,000 per year. Major upgrading of a plant air compression system costing $325,000 and a $100,000 conversion of a gas dryer system will yield a payback of about one year.

One company reported spending $600,000 on 22 equipment and instrumentation related upgrades that are expected to yield over $860,000 annually for a 10 month cost recovery period. In this company, identification and implementation of a large number of annual energy conservation retrofits has always been a routine activity.

Table I

Chemical Industry
Energy Efficiency Improvement

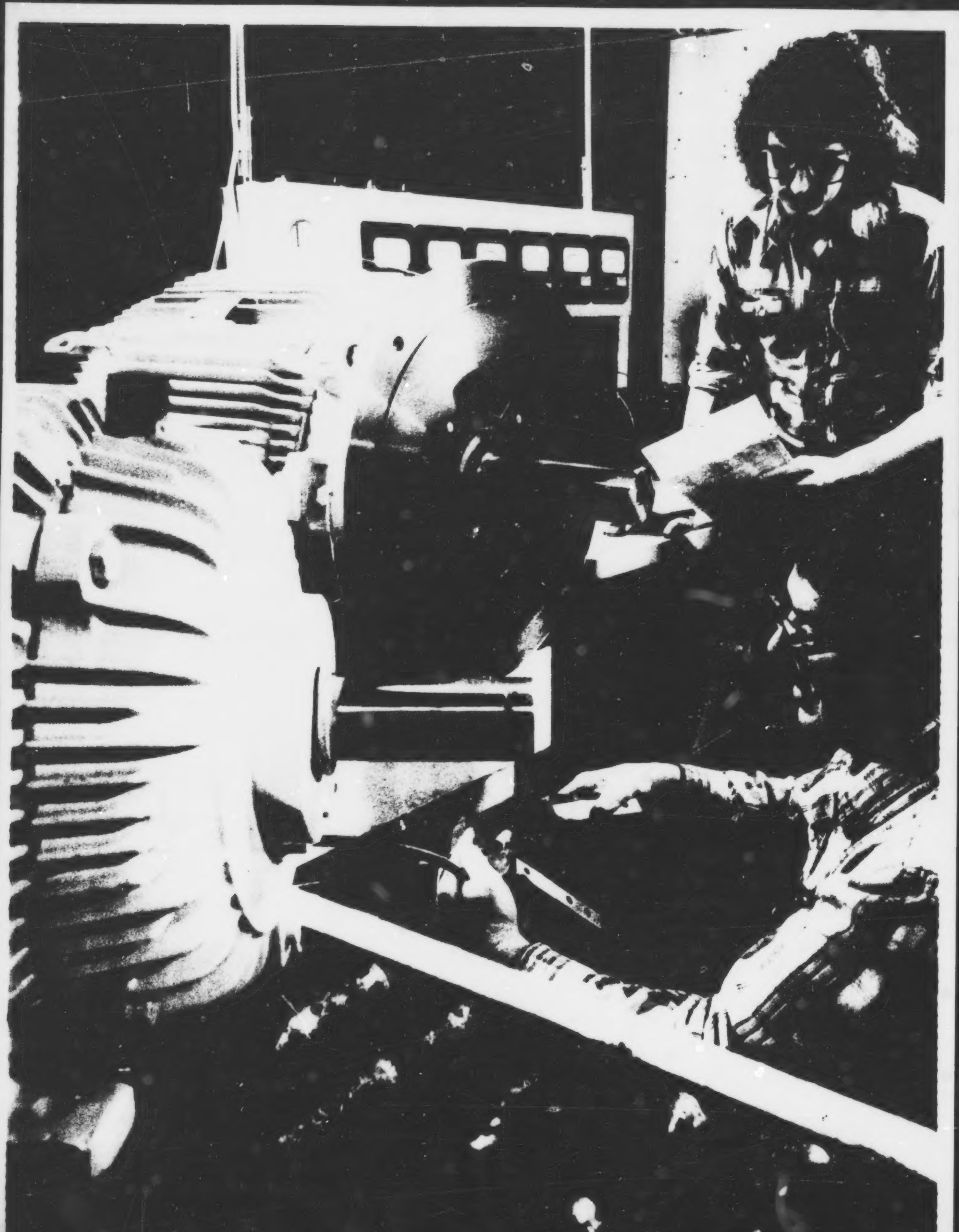
Current year (1988) total energy inputs		381.713 petajoules
Base year (1985) equivalent energy inputs		428.906 petajoules
Adjustments (1985-1988)		.371 petajoules
Net Improvement	= 11.1%	
Efficiency gain 1973 - 1985	30.0	
1986	4.4	
1987	5.2	
1988	1.5	
Total gain 1973 - 1988	41.1%	

Table II

Chemical Industry
Energy Use

Type	Units ('000)	Gigajoules	1988	1983	1980
Natural Gas	5,057,067 m^3	188,122,902	49.3	44.4	36.8
Electricity	10,331,932 kWh	109,012,210	28.6	34.7	31.1
Liquid Petroleum Products:					
Distillate Oil	69,531 litres	2,711,712	0.7	0.9	10.0
Residual Oil	181,490 litres	7,677,043	2.0	4.2	14.4
Diesel and Gasoline	11 litres	459	—	0.5	0.4
Other Fuels:					
Propane, LPG	257,609 litres	6,852,412	1.8	1.0	—
Coal & Coke	51.7 tonnes	1,201,400	0.4	0.3	2.3
Steam	n/a	12,501,805	3.3	2.0	1.0
Other Fuels	n/a	53,632,699	14.0	12.0	4.0
Totals	– 1988	381,712,677			
	– 1987	428,905,604			

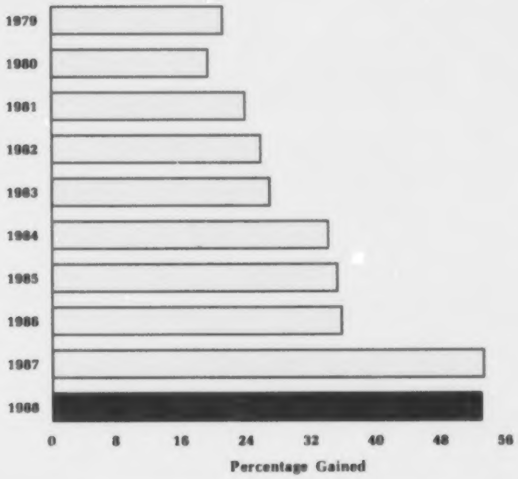
Other fuels include process by-products, vent gases, "drips", "slops", pitch, sulphur, hydrogen, waste oils, etc. Electricity is converted at 10,551 kj/kWh.



Electrical and Electronic Industry

Energy Conservation Task Force

Seth Duffus
Chairman



More than 200 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. These include generators, transformers, switchgear, lighting equipment, wire and cable, and electrical appliances. A host of electronic products, systems and related high technology components are manufactured by the companies represented by this task force. Most of the companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC) which acts as a secretariat for the task force.

1988 Performance

From 1975 to 1988 there has been a 53% total gain of energy efficiency. A noteworthy validation of the overall energy savings claimed can be found by comparing total shipments from the sector members, to the total energy used by those reporting to the sector task force surveys. From 1981 to 1987 shipments in constant dollars from EEMAC companies increased by 40%, while energy consumed by task force reporting companies was reduced by 30%. This is equivalent to a 50% improvement in energy efficiency.

Forty-five (45) companies contributed to the 1987 task force report. Fifty-eight (58) companies submitted data to the 1988 report. Of these 58 companies, 25 are new contributors. That is 30% more companies participating in the 1988 report over last year. Participation is increasing as people become more involved with environmental concerns. Of the 45 companies reporting last year, 25% failed to respond to the 1988 survey. It is difficult to accurately compare the results of 1987 to the figures of 1988 due to the large number of changes in survey participants.

A 45% target for improvement in effective use of energy had been set for 1990, but at this point the target has been achieved and surpassed.

1987 was a banner year for improvement in energy efficiency. The 16.2% improvement over 1986 (shown in Table I) was attributed to new manufacturing techniques, productivity improvements, and improved survey participation. Because 1987 was such a record year, an increase in overall energy efficiency was difficult to achieve for 1988, resulting in a small setback of – 1.2%.

Energy productivity rose in many individual plants because of increased operational capacity; plants operated at almost full capacity – 95% compared to 80% average in 1987. Benefits from the warmer winter were offset by the increased use of air conditioning during an exceptionally hot summer.

Energy Use Patterns

The well established trend to use electricity or natural gas in place of oil is dramatically shown in Table II. Oil has posted a steady decline to almost zero consumption. The

Photo – High Efficiency Motor Inspection
Westinghouse Canada Inc.

total energy use reported is 6,273,070 Gigajoules; 36.7% of this is electrical, and 57.6% is natural gas. There were, and still are, uncertainties in prices of energy forms – the deregulation of gas and the resulting wide selection of discount opportunities – and the yet to be determined impact of 'time-of-use billing' of electrical energy in Ontario.

Task Force Activities

Education was the driving force for the task force in 1988. A series of educational meetings including lectures and plant visits to the Canadian Centre for Occupational Health and Safety in Hamilton; the Energy from Waste facility at 3M in London; the Research Laboratory at Ontario Hydro in Etobicoke; the Edison Centre at General Electric's new corporate headquarters; and high technology manufacturing facilities at Garrett Canada in Etobicoke.

Renewed activity in terms of survey response occurred as a result of personal contacts made by Mr. Bev Markle. He arranged plant visits to assist many of the companies with data gathering, and to communicate details of sector programs and activities.

Future Outlook – The Challenge Ahead

The outstanding progress reported from 1975 to the present has been complementary to the objectives of CIPEC; the E&E sector has played a major part in this progress. As technological development increases in the electrical and electronic sector it provides a leading contribution in this as well as other sectors to the improved utilization of raw materials, the effective use of energy, and upgraded environmental objectives.

The task force will continue to concentrate on increasing involvement of sector companies and better survey reporting. The beneficial meeting format in 1988 has increased participation by energy coordinators. The new task force executive will continue to emphasize informative and technological presentations related to efficiency in plant operations.

Table I

Electrical and Electronic Industry
Energy Efficiency Improvement

Current year (1988) total energy inputs	6,273,070 GJ
Base year (1985) equivalent energy inputs	7,548,820 GJ

Net Improvement = 16.9%

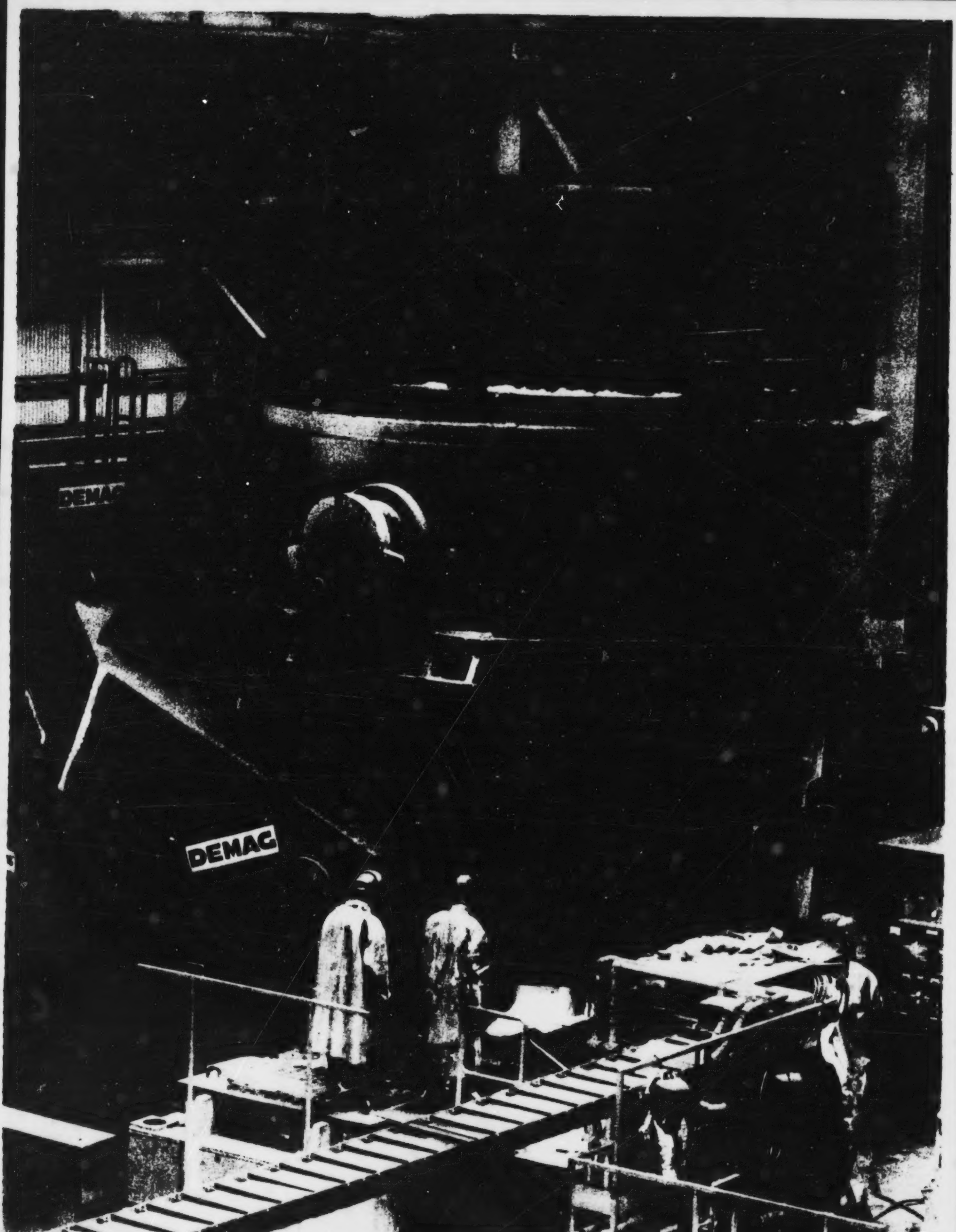
Adjustments — None

Efficiency gain 1975 - 1985	36.1
1986	1.9
1987	16.2
1988	–1.2
Total gain 1975 - 1988	53.0%

Table II

Electrical and Electronic Industry
Energy Use

Type	Units	Gigajoules	1988	1987	1986
Natural Gas	97,978,118 m^3	3,611,306	57.6	54.8	57.3
Electricity	639,808 MWh	2,299,708	36.7	41.1	37.5
Liquid Petroleum Products:					
Distillate Oil	1,644 kilolitres	64,111	1.0	0.9	1.4
Residual Oil	1,720 kilolitres	69,651	1.1	1.2	1.8
Diesel and Gasoline	355 kilolitres	13,494	0.2	0.1	0.4
Other Fuels:					
Propane	1,302 kilolitres	34,634	0.5	1.2	0.3
Steam	101,788,700 kilograms	180,166	2.9	0.7	1.3
Totals	1988	6,273,070			
	1987	6,689,830			
	1986	5,806,412			
	1985	5,841,065			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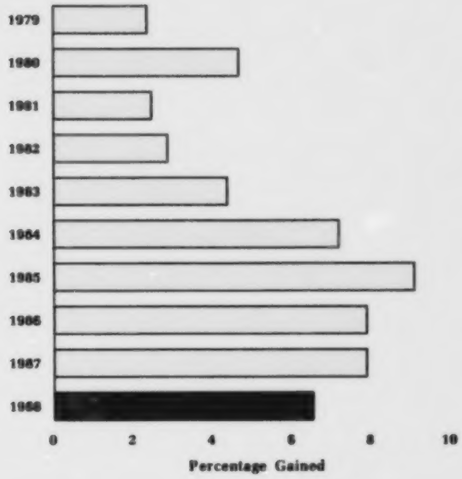
Ferrous Metals Industry

Energy Conservation Task Force

Don W.R. George
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1988 energy efficiency assessment include:

1. The Algoma Steel Corporation
2. Dofasco Inc.
3. Sidbec-Dosco Inc.
4. Stelco Inc.
5. Sydney Steel Corporation (Sysco)

Together, these companies represent about 79% of the total Canadian raw steel production and produce steel by the following techniques:

a) blast furnace, basic oxygen and/or open hearth process

b) direct reduction/electric furnace

c) electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed in the 33 plants operated by the member companies.

1988 Composite Energy Performance

Steel production increased in 1988 to 11,917,564 tonnes from 11,856,731 tonnes in 1987 – an increase of 0.5%.

The amount of energy consumed per tonne of raw steel was higher in 1988, at 23.19 x 10^9 Joules, than in 1987, at 22.87 x 10^9 Joules (an increase of 1.4%).

All participating companies achieved success in their plant energy conservation programs, with a number of these achievements listed at the end of this report. However, certain factors overshadowed the conservation achievements in 1988 and resulted in an increase in the composite energy rate. Some of these negative factors include:

- reduced scrap proportions in the steelmaking process
- interruptions to the normal operating pace due to major construction projects and breakdowns
- start-up and learning periods for major new steelmaking and processing equipment.
- increased purchases and processing of semi-finished steel.

Photo – Continuous Slab Caster
Dofasco Inc.

Progress Towards the 1990 Energy Rate Goal

In 1988, the energy rate at 23.19 x 10^9 Joules/tonne was 2.5% higher than the 1985 base year energy rate of 22.63 x 10^9 Joules/tonne and is 10.9% higher than the energy goal in 1990 of 20.91 x 10^9 Joules/tonne.

Task Force Technical Activities

The Technical Committee of FERA provides opportunities for member companies to exchange information on conservation activities, as well as to become involved in cooperative projects.

A Task Group of the Committee organized and hosted a meeting of the American Flame Committee (AFC) on May 10 and 11 in Toronto. The meeting theme was "Technical Developments Applicable to Reheat Furnaces" and included such topics as:

- View factors associated with heat transfer in metallurgical furnaces
- Modelling study of burners and furnace performance for oxygen enriched combustion systems
- Combustion system improvements for increased efficiency in steel plants.

Direct contact with federal government research facilities was maintained through the Energy, Mines and Resources (EMR) observer on the FERA Technical Committee. On November 8 and 9, the committee and invited company representatives visited the National Research Council (NRC) and the Canada Centre for Mineral Presentations and discussions were held on:

- steam generating heat pumps
- blast furnace coal injection
- an overview of the CANMET research activities

The committee also compiled and distributed to member companies, eleven implemented energy conservation 'opportunities'. In addition, eight case studies on variable speed drives were submitted and reviewed.

At the board of directors level, FERA has been successful in working with Queen's and McGill Universities to obtain approval for a $3.2 million industry/university research project entitled "Process Technology in Reheating Furnaces". The three-year project will be jointly funded by the Natural Sciences and Engineering Research Council (NSERC) and the industrial participants, Algoma, Dofasco and Stelco. In-plant and laboratory testing and mathematical modelling are expected to provide gains in energy efficiency, quality and productivity.

1988 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by task force members in 1988.

Modifications to Existing Equipment

- installed evaporative cooling hoods on steelmaking vessels.
- recovered condenser cooling water for processing into boiler feedwater.
- replaced the continuous pilot system on a BOF flare stack with an intermittent igniter system.
- installed economizer control valves to reduce gas used on cutting torches while on standby.

Operating Changes

- increased charging of hot slabs into reheat furnaces.
- purchase of nitrogen allowed shutdown of oxygen plant.
- shut down coke production facilities and grinding ball production mill.
- modified the fuel firing on blast furnace stoves to ensure a steady fuel flow.
- increased production of continuously cast product.
- increased production in electric arc furnaces.

Housekeeping and Repetitive Maintenance

- upgrading of building roof insulation.
- program to inspect and repair natural gas safety relief valves.
- steam system conservation programs (traps, leaks, insulation).

Conservation Projects for 1989

All participating companies expect to implement energy saving measures in 1989. A sampling of the more significant items includes:

- addition of a heat recovery system to a major reheat furnace
- modernization of electric arc facilities.

Table I

Ferrous Metals Industry
Energy Efficiency Improvement

Current year (1988) total energy inputs	276,388 terajoules
New base year (1985) equivalent energy inputs	269,669 terajoules

Net Improvement = –2.5%

Adjustments — None

Efficiency gain 1974 - 1985	9.1
1986	–1.2
1987	0.1
1988	–1.4
Total gain 1974 - 1988	6.6%

Table II

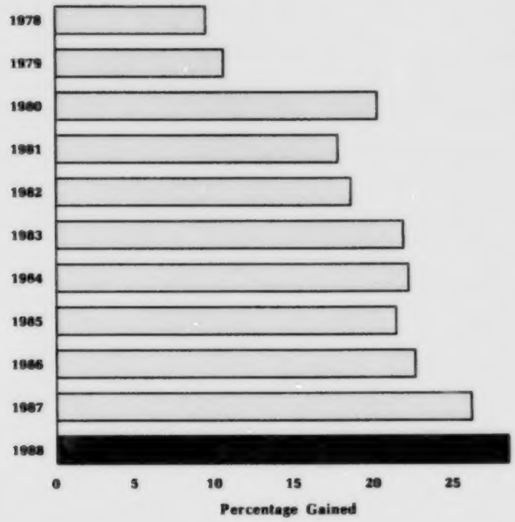
Ferrous Metals Industry
Energy Use

Type	Units	Terajoules	Percentage of Total Consumption 1988	1987	1986
Natural Gas	1,517,177,000 m^3	56,439	20.4	19.6	19.7
Electricity	6,167,222 MWh	22,202	8.0	7.6	7.6
Liquid Petroleum Products: Residual Oil	383,777,780 litres	15,543	5.6	5.1	4.6
Coal	6,282,897 tonnes	182,204	66.7	67.7	68.1
Total		276,388			

Food and Beverage Industry

Energy Management Task Force

Alexis L.W. Hyland
Chairman



Task Force Description

This report describes the energy efficiency performance of 145 companies that operate about 200 separate plants located throughout Canada. It is estimated that 42% of total energy consumption in the food & beverage industry is represented in this report. Three-quarters of the highly energy intensive companies that make homogeneous type products are represented. These include; biscuit manufacturers, brewers, distillers, and sugar manufacturers. In the more diverse sectors, coverage generally includes only the largest companies.

General Performance

Energy use per unit of production improved 2.8% during 1988 in the surveyed companies. This raises the overall improvement to 7.2% above the 1985 reference year or 28.7% over the consolidated 1977 base year. Current performance is slightly better than the 2.7% per year average rate of gain. However, not all groups registered gains, as noted in the individual reports.

Based on a total fuel and electricity cost of $252 million, the participants' total savings are nearly $100 million due to the aggregated performance improvement achieved since 1977. [1] Table 1 summarizes the individual sector performances and consumption. The distribution of energy sources and consumption trends are presented in Table 2.

Task Force Events

Another well-attended energy management seminar provided up-to-date information on new natural gas contract options, electrical time-of-use rates, improving heat transfer efficiency, pinch technology analysis, steam distribution system design improvement, and submetering program monitoring techniques for the benefit of food & beverage industry representatives.

A special pinch technology demonstration study at Moosehead Breweries in New Brunswick provided an indication of the potential for heat recovery in a typical brewing operation. The study was financed by Energy, Mines and Resources Canada. Results suggest that savings of about 3% of fuel costs are economically possible.

Group Performances

Bakeries

Energy in this sector, including Canada's largest integrated bakeries, slipped nearly 1% during 1988 because of lower production in some companies and introduction of some new brands that require slightly longer baking times. The total gain is still 5.1% better than in 1985 and a 17% improvement over 1979.

Aggregated energy intensity for the various products remains unchanged at 2,691 kJ/kg in spite of the small decline. This average energy intensity is still about 16% higher than large U.S. operations where larger economies of scale provide distinct cost and efficiency benefits. One Toronto company is well along in its plans to construct special new facilities to close this performance gap.

Baking techniques have changed in response to cost pressures and the very competitive demands of the market place. In the past, energy efficiency has been improved by decreasing baking times, minimizing refrigeration, optimizing inventories, and by some heat recovery. The next round of significant efficiency gains will probably be achieved through the use of fully integrated real-time data acquisition systems (DAS) and computerized controls.

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[1] This total savings figure should not be compared with previous year's since population is constantly changing. The figure is arrived at by applying the efficiency improvement to the estimated energy costs in the current reporting period.

Photo – Still House Control Panel
Joseph E. Seagram and Sons, Limited

While the impact of fuel shifts is not clear because some companies had no energy supply options, the increased consumption of electricity was a common phenomenon in all companies. The electrical power share has grown significantly from 13% in 1979 to 22% in 1988 while its share of total costs increased from 25% to 35%. This increase is due to new proofing techniques, and additional product refrigeration. Future growth levels are expected to be modest.

Biscuit Manufacturers

This survey covers 71% of all domestic biscuit manufacturing operations. There are sizable differences in energy intensities amongst the reporting companies, ranging from 5,000 to 7,000 kj/kg of output, and in energy costs which vary between 10% to 15% of total manufacturing expense.

Energy consumption per unit of production increased 1.7% this year. In the past, the performance gains averaged the same 1.7%. No significant business reasons were evident for the reversed trend. Survey results indicate few retrofits have been installed in the past two years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. If these activities are relaxed, however, performance usually suffers.

Biscuit manufacturers now rely on electricity for nearly 22% of their total energy consumption and on natural gas for the remainder. Total costs are split into 24% for electricity, 56% for natural gas, and 20% for fuel oil.

The participants said their overall attention to conservation was "increasing" even though energy is still considered a "low to medium" cost factor. Two companies mentioned installing additional electrical capacitors to raise power factors and avoid cost surcharges.

Breweries

The results of 17 breweries located in each province are summarized in this survey. Two of the largest multiplant companies have recently decided to merge and rationalize several of the smaller facilities. The impact on energy efficiency is yet unclear. There is also a growing number of independent microbreweries in the country that are beginning to participate in the survey results.

Energy efficiency improved 1.7% in 1988, boosting the total gain to 9.2% since 1976. The industry's average energy intensity is now down to 299 MJ/HL. The largest plants appear to operate at about twice the energy efficiency of the smallest plants. Before the trend to local micro-breweries, many small plants were built to satisfy provincial regulations for local production rather than for optimum efficiency. In general, energy expenses amount to about 7% to 15% of direct factory costs.

Even though impressive energy improvements have been made in most breweries, overall efficiencies do not show the effects of frequent shifts to higher energy-intensive brands and major changes in bottling operations. Nevertheless, this industry demonstrates its "high" regard for energy conservation by the actions it has taken recently. Pinch technology studies at Moosehead and installation of a submetering DAS system at Molson's in Toronto are two examples cited in 1988. Housekeeping activities are always mentioned as routine sources of energy conservation opportunities.

Energy substitutions and conservation completed since 1979 have had varied impacts on manufacturing costs. During this time period, additional natural gas use pushed the gas share from 55% to 66% while the heavy fuel oil consumption dropped from 18% to 3% of the total mix. Electricity's share of total consumption has increased from 18% to 27%, but its share of total cost has increased a lot more since it is a more expensive commodity.

The 9.2% energy conservation gain applied to the current energy cost of $48.5 million amounts to a rewarding $4.9 million savings.

Confectioneries

While productivity was level in 1988, efficiency has gained 7.5% since the new 1985 base year and stands at 25.6% since the 1981 reference year. These gains have been achieved by extensive rationalization of operations and large-scale modernization of present plant facilities. Companies have thus become very efficient in a short period of time.

Electricity now supplies 30% of the total power and natural gas 65%. These proportions have not changed significantly in the past 10 years, suggesting that little change can be made in the basic production technologies of batching, blending, cooking and packaging.

The ice cream making process requires approximately 15 MJ/kg while chocolate production uses about 13 MJ/kg of output. Many popular products such as chewing gum require only about 2 to 5 MJ/kg of output because of their lower processing and refrigeration requirements.

The estimated energy cost of $8 million for the group means that about one-half the total domestic manufacturing capacity is included in this survey. Energy costs usually amount to about 15% of direct manufacturing expenses in this industry.

Distilleries

The distillery industry suffered a 3% decline in energy efficiency during the year primarily due to reduced capacity utilization. The industry's output is down 5% from 1987 and 25% since 1981. Some companies have opted to take extended shutdowns for inventory adjustment, plant revisions and maintenance. Nevertheless, efficiencies are still 23% better than average 1977 operating conditions.

Distilling is a very energy-intensive process that requires large quantities of steam as the motive power. To augment the extensive retrofits made in power houses and distribution systems, distilleries are now installing mechanical vapour recompression systems to reduce steam demand and fuel costs. Natural gas now supplies 87% of the total energy (76% of the total expense) with electricity accounting for 9.7% of the energy and 20% of the cost. The only change in the past ten years has been a 17% gain in natural gas share at the expense of heavy fuel oil.

In addition to steam and process improvements, installation of submetered monitoring systems indicates that operating efficiencies are watched closely.

Aggregate energy intensity is now 41,810 kilojoules per (absolute) litre of product.

Food Processors

Energy conservation in this group is complicated somewhat by the seasonal nature of production and the necessity for quick processing. Food processors generally employ extensive heating and cooling systems that require close attention to minimize losses. Some progressive companies have tried solar heating to preheat water but these systems are often feasible only with financial subsidies.

The results of this year's survey show that aggregate energy efficiency slipped 0.6% mainly because of lower production rates caused by the summer drought. The normal rate of efficiency improvement is slightly over 2% per year.

No mention of significant energy conservation improvements was made in the survey. However, one southern Ontario plant is planning to install a 5 megawatt cogeneration installation to further benefit from their low "direct purchase" natural gas costs and, at the same time, help alleviate the fully loaded electrical distribution network in that area.

Food processors have made a dramatic shift away from fuel oil to interruptible natural gas in the past 10 years. Over this period, the share of heavy fuel oil has decreased from 57% to 18% while natural gas has shot up from 20% to nearly 60%. The electricity share has remained stable near the 20% level. Where large swings in monthly gas consumption normally draw large contract cost penalties, in some cases the suppliers are receiving benefits since the summer loads offset the system winter peak. In Quebec, a few companies have installed electric steam boilers to take advantage of competitive energy pricing and the higher conversion efficiencies.

Fisheries

1988 was a good year for improved energy utilization in this sector. Aggregate efficiency went up 3.1% to boost the overall rate to nearly 30% over the reference 1978 base year level. Since this gain is moderately faster than the normal 2.8% per year rate, it is concluded that recent industry-wide rationalizations have had a positive impact.

Electricity is the dominant source of energy in shore processing operations supplying 39% of the total consumption.

Large refrigeration systems are used to make the vast quantities of ice for chilling stock-in-process and for freezing and cold storage. It is estimated that about 55% of the electrical load is used for plant refrigeration. In the Maritime Provinces, where ratchet-rate structures do not exist, any single peak demand usually sets the demand rate for the entire year. Therefore, this industry's search for higher electrical efficiencies and enhanced refrigeration technologies is a major focus of attention.

Fuel oil supplies nearly 35% of total energy, followed by natural gas with 17%. Some quantities of waste fish oil are reported as a source of energy but the majority is reprocessed and sold as fish meal and fish oil.

Energy conservation has always been treated as a "high" priority activity in this sector because of meagre profits and high energy prices, especially electricity. Survey indications say priorities will "remain the same" in future.

Grocery Products

Companies in this sector make or process a large number of different products such as coffee, pastas, soaps, and canned and frozen foods. Those companies with extensive process heating, evaporation, and/or product refrigeration often have energy intensities near 20,000 kJ/kg. However, the majority of companies in the survey have intensities in the 10,000 kJ/kg range and therefore indicated their concern for energy was "medium and holding steady".

This group's energy efficiency improved 1.3% during the year which boosted the gain since 1985 to 4.9% and the overall improvement to 28.3% since 1978.

In the past 10 years, consumption of natural gas has nearly doubled (38% to 71%) while heavy fuel has followed an opposite trend. Much of the fuel oil used is for contract quantity optimization and for backup under interruptible gas contract requirements.

The overall electricity share has changed little from 19% to 22% even though many of the Quebec companies had switched to electric steam boilers two years ago. This year, most of the surveyed companies highlighted the increasing efforts at improving distribution and lighting systems, with transformer replacements and maintenance getting special mention. Several companies also report having to install extra line filters to deal with electrical "noise" and harmonics now that electronic equipment is ubiquitous.

Meat Packers

The meat processing industry continues to experience swings in efficiency improvement partly because of varying production levels, changing government hygiene standards, rationalization of operations, and a slow rate of investment in new equipment. After experiencing a sizeable decrease in energy performance in 1986, a gain of 5.3% was reported in 1987, slowing to 0.7% in 1988. Nevertheless, long term performance improvement is 42.6% since 1977.

While companies' energy "housekeeping" actions often focus on waste water heat recovery and steam use, government regulators have recently tightened refrigeration requirements to preserve product quality. This, together with greater use of electrical heating in some processes, has pushed the electricity share of total consumption up in the last ten years from 18% to 29%. In so doing, it has raised the electrical cost share from 37% to 49%, making it a very serious component of energy budgets.

Larger companies are starting to introduce real-time data acquisition systems (DAS) for energy management and control. J. M. Schneider Inc., for example, is one company participating in the on-going Ontario Hydro/Ontario Ministry of Energy submetering demonstration program.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors, each with different energy requirements. For example, energy intensity for the egg and egg product processors averages about 4500 kJ/kg while the poultry processors' average is 2540 kJ/kg of product.

Energy utilization improved marginally by 0.8% in 1988 to raise the gain to 2.3% since 1985. While housekeeping activities have provided the bulk of efficiency gains to date, some HVAC, lighting, and a few major heat pump installations have helped.

Plant energy use now appears level but delivery truck fuel efficiency is getting more attention. Nearly all the respondents gave energy management a "medium and steady" priority. One large integrated company mentioned still having an energy committee in operation to sustain their conservation program.

Electricity is the dominant source of energy in this industry. Some Quebec plants are totally electric-powered. Elsewhere, plants get about one-half of their energy from electricity.

Soft Drink Producers

The carbonated beverage industry consists of many market-centred operations that make a number of popular brands under license. Energy is used mainly for building HVAC, container sterilization, filling, and refrigeration. Bottlers usually require about 3,500-4,000 kJ per litre while canners, with less clean up and sterilization, use between 1,000 to 1,500 kilojoules per litre.

This sector's energy per unit of production increased 1.5% in 1988. Since the situation was widespread, one can only speculate on the probable causes since no common reasons were cited on the questionnaires. This group is going through a strategic business reorientation where production is being concentrated into larger facilities with delivery from local terminals. It will take a little while before these new arrangements have a positive impact on the long term performance trend.

Typical energy proportions in a mixed bottling/canning plant are: 5% electricity, 35% natural gas, 30% diesel fuel, and 30% gasoline and propane for fork trucks. Natural gas, the preferred heating fuel, is normally purchased under general service contracts because annual consumptions of about 100,000 m^3 are insufficient to make direct purchase arrangements viable.

Starch Manufacturers

Driven by high energy expenses and business competition, manufacturers in this energy-intensive sector raised their total performance improvement by 1.8% in 1988. The total gain since 1976 is now 34%. Based on an estimated energy cost of $32.8 million, the saving relative to the base year is $17 million (at current prices) which has been achieved from various improvements.

Most companies purchase their natural gas on "Buy-Sell" agreements with considerable cost savings. While the natural gas share of the total is 81%, its cost share is much lower at 64% making it the most economical source of fuel. Electricity provides 16% of the total energy but costs some 30% of the total energy expense.

Manufacture of such products as wheat and corn starch, glucose, alcohol, gluten feeds, adhesives and resins usually requires between 10,000 to 12,000 kJ/kg of product. To make some of these products, e.g. corn wet milling, it is economical to use modern electro-technologies such as mechanical vapour recompression (MVR), cogeneration and heat pumps.

One of the largest companies in the group, Casco Inc., won the Canadian Electrical Association's Regional Industrial Energy Efficiency Award in 1988 for outstanding energy conservation efforts. Casco was cited for its very efficient mechanical vapour recompression and heat pump installations. In the wet-corn milling operations, new MVR equipment more than quadrupled the original evaporation rate of 4 pounds of water per equivalent pound of steam feed to the double-effect evaporators. Two intermediate evaporators were redeployed to perform additional finishing operations. Production was thereby increased close to 30% and energy costs for evaporation were reduced by almost 50%.

The 200 HP heat pump installation is used to cool a product before shipment. The value of the recovered heat was sufficient to pay for this project within 2 years where other solutions would have provided no return.

Sugar Refineries

Performance improved 4.5% during 1988. This faster than usual rate of increase raises the operating efficiency to 7.7% over the new 1985 base year level and 36% better than original 1975 operating conditions.

Rationalizations and operation of existing facilities at higher capacities, plus implementation of energy audit recommendations account for the surge in efficiencies.

Sugar refining is a process where electro-technologies such as MVR and heat pumping have yet to be introduced. The aggregate energy balance is now 4% electricity and 96% for fuel – approximately two-thirds of which is used to generate steam for raw sugar melting and slurry evaporation. Improvement of the conventional evaporation procedure would provide significant efficiency gains judging from the experience noted in the starch companies report.

Wineries

Since this year is the first year that several wineries have participated in the energy management survey it will not be possible to give a synopsis of their performance until a later date. However, it is a clear indication of these companies' concern for productivity in their operations that they submitted their results.

Table I

Food and Beverage Industry
1988 Sector Results

	Number in Survey	1988 Imp. %	Total Imp. %	Base Year	Energy Cost ($,000)	Total Savings ($,000)
Bakeries	4	–0.9	17.0	1979	7,759	1,589
Biscuit Manufacturers	6	–1.7	13.7	1979	6,198	985
Breweries	6	1.7	9.2	1976	48,521	4,946
Confectionery	10	8.0	33.2	1981	8,035	3,993
Distilleries	8	–3.1	22.9	1977	21,667	6,465
Fisheries	3	3.1	29.6	1978	9,180	3,863
Food Processors	11	–0.6	22.5	1976	36,210	10,496
Grocery Products	15	1.3	28.3	1978	17,839	7,038
Meat Packers	8	0.7	42.6	1978	24,211	17,997
Poultry and Egg Processors	14	0.8	10.5	1982	7,894	930
Soft Drink Producers	48	–1.5	26.6	1980	12,657	4,596
Starch Manufacturers	4	1.8	34.2	1976	32,853	17,076
Sugar Refineries	5	4.5	36.0	1975	18,994	10,692
Wineries	3	—	—	1988	127	—
Food and Beverage Task Force	145	2.8	28.7	1977	252,145	90,666

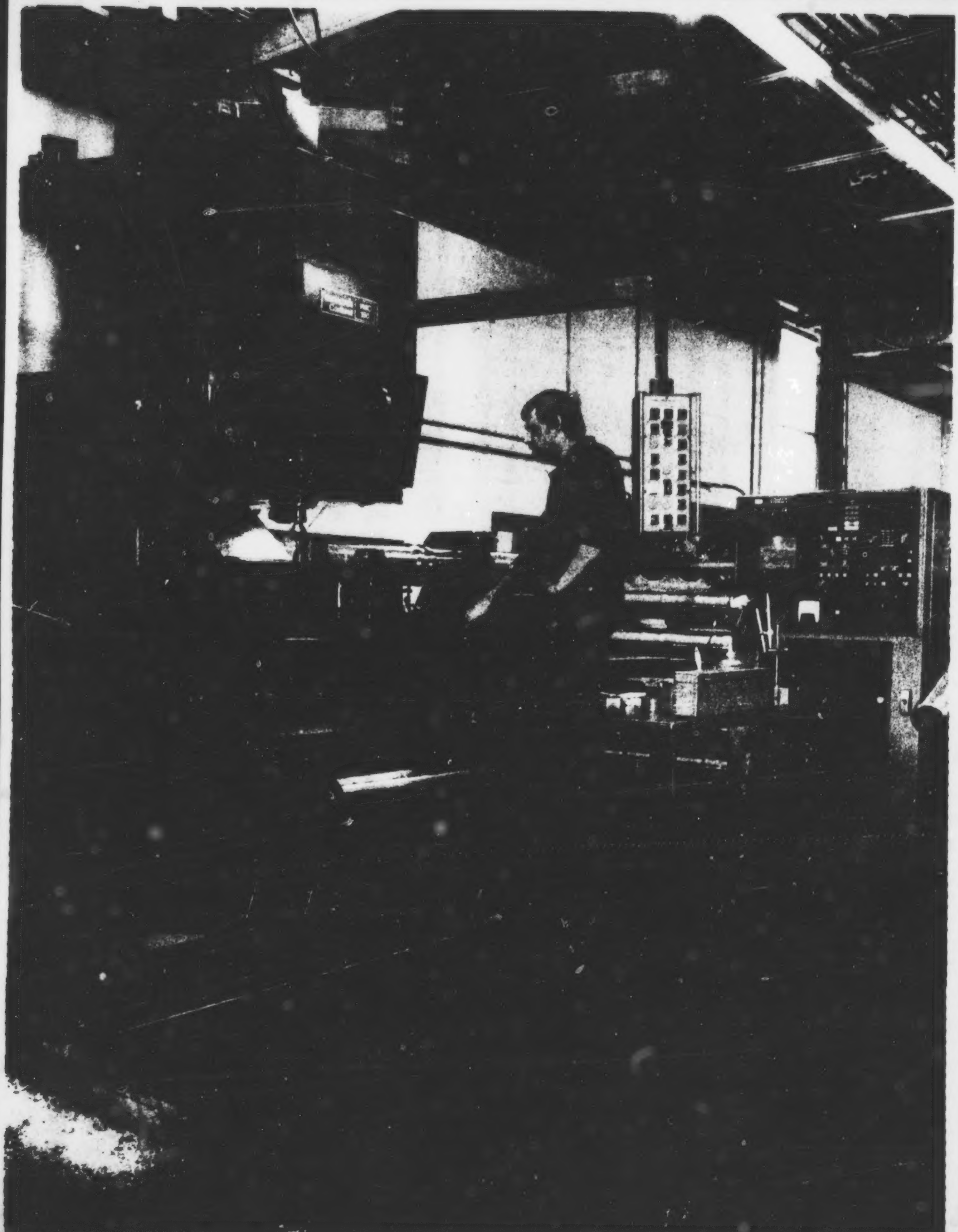
Table II

Food and Beverage Industry
Energy Consumption Statistics

Energy Type	Units	1987 Consumption TJ(10^{12})	Energy Distribution 1988	1987	1979
Electricity	2,295,769 MWh	8,265	21.9	20.7	16.9
Natural Gas	679,825,499 m^3	25,290	66.9	68.3	40.8
Fuel Oil	81,571,994 L	3,239	8.6	9.3	26.7
Propane	12,029,568 L	319	0.8	0.5	—
Diesel & Gasoline	20,293,000 L	578	1.5	0.9	15.0
Steam	n/a	110	0.3	0.3	0.6
Others	n/a	3	—	—	—
Total		37,804			

1985 Base Year Equivalent Energy: 40,724 Terajoules

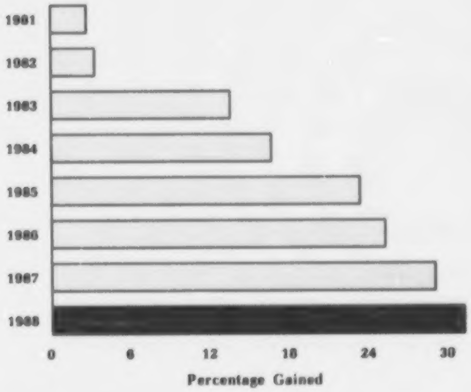
Efficiency Increase to 1985 = 21.53%
1986 = 1.24%
1987 = 3.15%
1988 = 2.78%
Total Increase = 28.70%



General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



This report is based on a survey of members of The Canadian Manufacturers' Association (CMA). Companies have again been assigned to one of four main categories according to their general manufacturing technologies and energy intensities. Since most of the 50 participating companies have responded to the survey for several years, trend analysis is enhanced with the consistent grouping.

General Performance and Business Conditions

Consolidated energy efficiency improved 3.0% in 1988, boosting the total gain to 8.7% over the new 1985 base year and 32.1% above the aggregated 1980 reference year.

Based on an estimated total cost of $130.6 million for fuel and electricity, the reporting companies saved $4.0 million in 1988 or $61.8 million since the base year. In 1988, the $6.55 per gigajoule average energy price is somewhat lower than in 1987 because this year's mix of responding companies reported using more "waste" fuels and slightly less electricity.

The 1988 performance gains appear to be the result of diversified energy conservation efforts, whereas some of the more spectacular gains recorded in recent years were attributed to exceptional business related factors. To date, the highest gain ever registered in this group occurred in 1983 (see Figure 1) when a 10% improvement resulted from concerted efforts to improve post-recession productivity. Another extraordinary efficiency surge (6.7%) occurred in 1985 when the industry's GDP rose 4.6% and capacity utilization was driven up 3%. Compared to these two outstanding years, 1988's increase of 3% reflects a more normal situation when capacity utilization (87.9%) was steady, spending on new capital machinery and equipment remained healthy and increases in energy prices were modest.

There was a broad focus on energy conservation, judging from the variety of responses on the survey questionnaires. This is a change from 1986 and 1987 when deregulated natural gas contracts and energy pricing received the most attention.

In 1988, energy conservation activities in this mixed group were equally divided into process and building improvements. At point of use, electricity and combustion systems were given equal attention. Expressions of interest in the use of computerized energy monitoring systems is beginning to be seen more frequently in the surveys. Energy managers in this sector, however, are generally concentrating on the basics.

In the process improvement category, apart from equipment upgrading, some companies appear to have discovered cost improvements from switching steam power to compressed air. This change usually means greater consumption of electricity but less overall waste and less

Photo – General Manufacturing Task Force

system idling. Some companies are looking seriously at the energy content of their products and report design changes to lower utility consumption. Using waste heat to dry raw materials and preheat water is a much more common practice.

Building improvements most often mentioned were added insulation to walls and roofs, upgraded windows, and reduction of general ventilation rates. Heating systems are a constant problem with different companies trying various solutions. For example, while one company mentioned cutting back on its radiant floor heating system, another said it had switched from steam heating to a natural gas radiant pipe heating system while yet another was investigating a special solar heating system.

Electrical improvements most often involved upgrading lighting systems. Demand control apparatus and additional capacitors to improve power factors drew limited comment. Scarce reference to high efficiency motors and process heating systems would suggest these measures are not yet a viable concern.

Combustion improvements involved the most innovative solutions. Companies appear to be opting for impulse or regenerative burners. Stack economizers are still being installed. One company is supplementing its natural gas fuel use with waste hydrogen, while another is burning its waste oil. Upgrading boiler controls appears to be an ongoing activity. Recovering baghouse air with a secondary filter will eliminate the need for a steam boiler in one site.

The various actions described above reflect some important realities about energy conservation in the general manufacturing sector. They demonstrate that basic, practical changes in the plant can still yield a solid 3% efficiency gain, but very vigorous activity is required to push performance to the 5% or 6% level, as experienced in 1985. Perhaps this added incentive will come from the provincial electrical utilities' new demand side management (DSM) programs now in the development stages. Utilities have discovered what end-users learned back in the middle 1970's – conservation is the lowest-cost source of new capacity. Additionally, manufacturers around the world are discovering that energy management also plays a very significant role in reducing industrial pollution.

Group Trends

Rubber Products

The $2 billion Canadian rubber industry, dominated by seven large tire manufacturing plants, is still experiencing the impact of major rationalizations in addition to modest initiatives to modernize remaining facilities.

Energy use per unit of production for this group improved 5% in 1988 which raises the total gain since 1981 to 34%. The solid 1988 gain, higher than the normal 3% improvement, is largely due to the shutdown of two large old plants – one a 50-year-old operation in Etobicoke, Ontario and the other in Hamilton. One new plant was built in Napanee, Ontario, to help service future markets.

Other sites report the type of modest improvements, e.g., upgraded boiler controls, electrical systems, etc., that imply a strategy of investing only in projects with quick returns. Tire companies are tied closely to the fortunes of the automobile manufacturing industry which, by mid-1989, experienced a drop in sales over 1988. Hence, the most recent efficiency gain may not be maintained unless there is renewed concern for productivity improvement.

The electricity share of total consumption is nearly 35% in the surveyed companies. Much of this is used for extensive materials handling systems. Because this consumption amounts to 48% of total energy budgets, companies have put a lot of effort into minimizing electrical expenses, especially demand charges. Electrical consumption has slowly risen by about 2% per year during the past 5 years of monitoring.

The balance between the mix of fuels, now 29% natural gas and 35% heavy oil may change slightly in the next few years as more plants are affected by overcapacity and shutdowns. It is expected this will occur mainly in regions now serviced by natural gas.

Specialty Chemicals and High Intensity Products

The six companies in this group make a variety of energy-intensive products including sodium chlorate, fibreglass insulation, and specialty chemicals. With this product diversity and the major energy conservation changes made in 1988, consolidated results are often difficult to generalize.

For example, Canadian Occidental Petroleum Ltd. changed its electrolytic process and boosted the group's base results from 4.6% to a whopping 24% gain for 1988. This single change was so dramatic that it raised the whole general manufacturing group performance by nearly 1%. As well, Occidental is now burning by-product hydrogen as a fuel. With its huge electrical load, control of the power factor in the 99% range is a necessity.

In contrast to this example, other companies in this group must resort to plant equipment upgrading and careful control of work practices to save energy. One firm mentioned its conservation program now includes avoiding indiscriminate use of lighting and the continuous heating of plant hot water.

Foundries, Forging, and Heavy Metal Operations

The 23 companies reporting in this highly energy-intensive category had mixed efficiency gains that resulted in a group improvement of slightly over 1% for the year. Consolidated energy intensity gains stand at 6.2% since 1985 and 12.7% since the old 1981 base year. This group's energy shares amount to: 35% electricity, 48% natural gas, 12% coal and "waste" fuels, and 5% light fuel oil for interruptible gas contract purposes. The increased amount of electricity consumption shows that induction melting has become a widespread practice in this sector.

Energy management in this group apparently is given a mixed priority, according to the survey responses. Even when very similar operations in the same locality are compared, rankings vary from "low and the same for the next two years" to "high and increasing". Yet energy costs usually amount to about 7% of shipment values in foundries, nearly 10% for smelting and refining, compared with 4% for all manufacturing industries. On a value added basis, energy costs amount to 13% in the foundry sector, 24% for smelting and refining and 9% for all industries.

Light Manufacturing

Eighteen companies reported an aggregate improvement of 4% in 1988. This raises the aggregate improvement in energy intensity to 9.7% since the new 1985 reference year. In this group, electricity provides 25% of the power and natural gas 70%. Most of the natural gas is used for building heating.

Typical plant energy-intensities in this group are: metal stamping operations, 6440 kW/m^2 of floor space; office equipment and furniture manufacturing, 795 kW/m^2; scientific and photographic equipment plants, 830 kW/m^2; aluminum extruders, 1080 kW/m^2; and machine shop type operations, 1150 kW/m^2.

The light durable-goods manufacturing sector is facing extremely tough competition because of lower-cost imports. Other factors, such as multinationals' "product mandating" and Canada's relatively higher domestic labour costs and small or diffuse markets, are placing intense pressures on productivity.

Many old plants have already been shut down because they were no longer viable. Some companies have merged with others or have been taken over to improve efficiencies through expansion. Aggressive companies like Bombardier Inc. have invested heavily in product development and expanded into world markets. Not surprisingly, energy efficiency gains being reported by the companies in this group generally reflect these changing circumstances.

Table I

General Manufacturing Industry
Energy Use

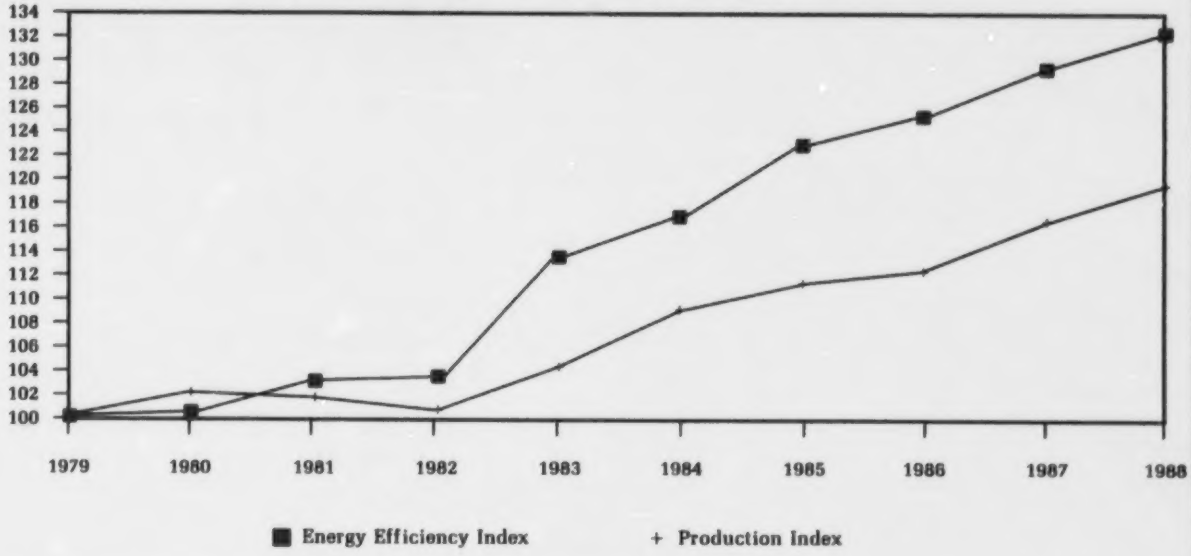
Type	Units	Gigajoules (10^9)	Percent Distribution 1988	1987	1985
Natural Gas	268,061,194 m^3	9,971,877	50.1	51.7	60.2
Electricity	1,660,707 MWh	6,698,547	33.6	37.6	28.1
Liquid Petroleum Products:					
#2 Oil	6,219,253 L	242,551	1.2	0.2	1.2
#6 Oil	31,540,543 L	1,277,393	6.4	8.8	9.6
Diesel	2,594,264 L	103,511	0.5	0.6	0.4
Gasoline	1,814,657 L	65,691	0.3	0.5	0.1
Other Fuels:					
Propane	8,469,509 L	225,289	1.3	0.3	0.3
Steam	n/a	36,433	0.2	0.2	—
Others	n/a	1,288,950	6.4	0.1	0.1
Totals		19,910,242			

1985 Base Year Equivalent Consumption: 21,813,333 Gigajoules

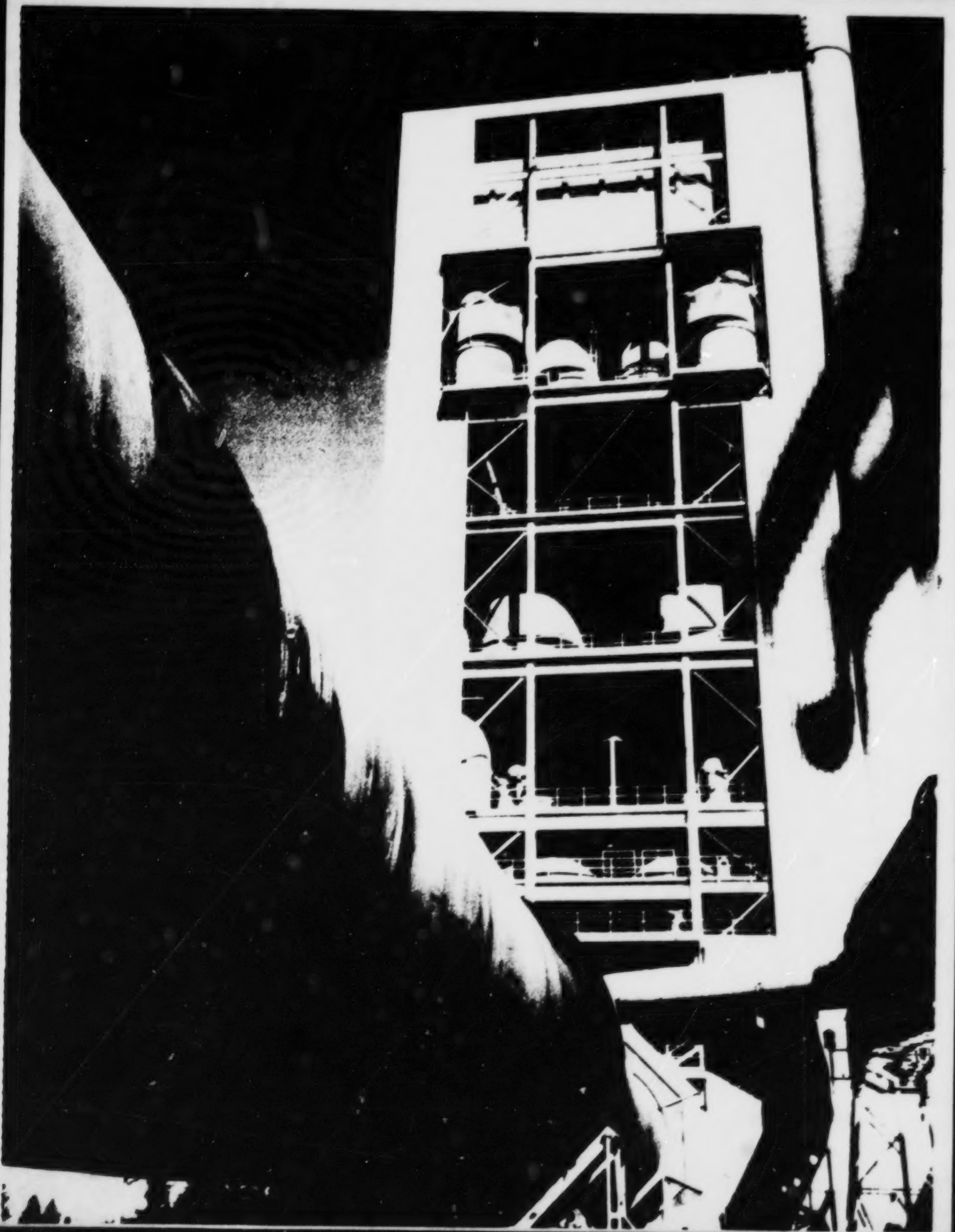
Energy Efficiency Gain between 1981 and 1985:		23.4%
	1986:	1.9%
	1987:	3.8%
	1988:	3.0%
Total Energy Performance Improvement:		32.1%

Figure I

General Manufacturing
Energy Efficiency Index and Production Index



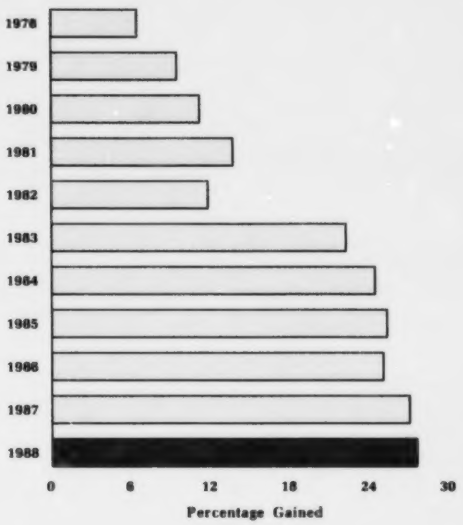
Source: Statistics Canada 31-003, CIPEC reports.



Industrial Minerals Industry

Energy Conservation Task Force

John A. Clarke
Chairman



Task Force Description

The Industrial Minerals group consists of 9 different sectors that mine, process and/or manufacture a variety of non-metallic products for subsequent use in the construction and steel industries. The combined GDP of these sectors amounted to $11 billion in 1988.

This survey covers an estimated 92% of the total energy consumption in the industrial minerals industry. About three-quarters of the total energy consumption in the highly energy-intensive ceramics industry (abrasives, brick and tile, glass, and refractory) is included in this survey. Porcelain and pottery manufacturing companies normally do not participate. All of the cement manufacturing, half the lime producers and about one-quarter of the concrete products and miscellaneous minerals processing companies in Canada are included.

General Performance

Energy efficiency gained 0.6% in 1988 to raise total improvement to 2.4% above the new 1985 reference year and 27.8% over levels established in 1975 when monitoring began.

Based on a calculated total cost of $433.5 million for fuel and electricity, reporting companies saved $2.8 million in 1988 for a total of $166.6 million since the base year[1]. Table 1 shows group performances and energy costs. Table 2 displays consumption of each type of energy.

Very little of the total efficiency improvement has come from new or revised processes in this industry. Most of the manufacturing processes are very mature and not subject to major changes. There is improvement potential, however, as noted in the individual sector reports. Maintaining the effectiveness of equipment insulation, heat recovery, closer control of combustion systems and electrical demand are common opportunities for energy conservation throughout the industry.

As might be expected, those sectors with the highest energy intensities, e.g. glass, cement, refractories and abrasives, still regard energy conservation as a "high priority" activity. Most surveyed companies in the medium and low intensity sectors say the status of energy management is currently holding firm but not necessarily increasing. Energy-related improvements must compete with other business opportunities for capital where a two-year payback is still desired.

The pattern of fuel substitutions throughout the industry has been mixed because of practical restrictions on the ability to burn different fuels. As well, minor variations occur from year to year because of slight changes in the reporting population. Energy distribution is shown in Table 2.

Energy substitutions have had a noticeable impact on the allocation of energy budgets. Since 1979, while the group's proportion of electricity use rose only 2%, its share of total cost has risen 15%. At current prices, this translates into about $54 million being redirected to electricity. This situation has become a major concern to companies in the electricity-intensive sectors, particularly in the abrasives and refractory manufacturing operations, where electrical costs are regularly compared with those of foreign competitors.

While there has been only a 6% share reduction in natural gas use since 1979, the large drop in deregulated prices has resulted in a savings of $37 million among participating companies. Nevertheless, natural gas is still the dominant fuel used in the industrial minerals industry.

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[1] This total cost savings figure should not be compared to previous year's since variations are introduced when companies fail to submit their results for consolidation.

Photo – Cement Kiln and Heat Recovery Tower
St. Lawrence Cement Inc.

The decline in fuel oil consumption proceeded faster than falling prices, driven by government substitution incentive programs and concerns about availability. Between 1979 and 1988, the fuel oil share dropped from 27% to 8% of total energy while the proportion of total cost declined from 28% to 11%. In so doing, some $41 million was trimmed from this category of energy budgets. The very slow rate of decline in the fuel oil share now appears to signal that a new economic balance point has been reached.

Coal has had a major impact on reducing the consumption of fuel oil as well as a minor effect on natural gas. During the 1979 to 1988 period, consumption of coal has more than doubled from 16% to 36%, but its percentage of total energy cost has only risen from 6.7% to 10.8% in the surveyed companies. As a result, an additional $13 million has been shifted to coal.

It is difficult to generalize on the impact of capital spending on energy efficiency because of the vast difference in capital and energy intensities, rate of spending, etc., in various sectors. However, the impact of annual spending on new machinery, growing from $193 million in 1985 to $359 million in 1988, has helped raise production capacities far more than energy efficiencies. Moreover, early indications of slower future capital spending and the prospect of lower capacity utilization rates does not appear to support continued energy efficiency improvement.

Sector Reports

Abrasives

This industry consists of 5 companies that make energy-intensive raw aluminum oxide and/or silicon carbide by electro-fusion technologies.

Silicon carbide is made by fusing coke and sand together in large donut-shaped electric resistance "furnaces". The energy intensity of silicon carbide production varies between 12,000 and 14,000 megajoules per tonne of product, depending on the size and configuration of the furnace. About 88% of the total energy is supplied by electricity and 12% from natural gas which is used for exhaust gas cleanup. Heat is captured from the raw coke but this does not enter into the efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina with fluxing agents and other admixtures in conventional electric arc furnaces. The electrical intensity of this process is in the 10,000 megajoules per tonne of product range.

Since no major energy substitutions have occurred, it is estimated that 97% of the total 10.4% efficiency gain since 1982 has come from more efficient control of electricity. This has resulted in a total cost saving of about $5.8 million in the surveyed companies.

Energy management actions common now are the careful control of production scheduling and product quality control to avoid excessive energy input, poor electrical conductance and distribution system losses, and excessive losses during the initial stages of arc furnace melting.

Future energy savings might come from application of plasma extended arc reactor (PEAR) technology. Pilot plant studies are now being done outside Canada although Ontario and Hydro-Qubec have conducted applied plasma arc research for many years.

Asbestos

After several years of reduced markets and capacity rationalization, 1988 saw a slight increase in asbestos production due to development of new markets in Asia and Europe. Production amounted to 705,000 tonnes, up 40,000 tonnes from 1987.

As a result, energy use per unit of production decreased 3.8% in 1988, bringing the total efficiency gain to 10% over the new 1985 base year. The overall gain since monitoring began in 1979 is now 15.8%

Some $46.1 million is spent on fuel and electricity in this sector, where four open-pit mines are located in Quebec and one company, situated in British Columbia, is producing from both an open-pit and an underground operation. Consequently, there is a wide variation in energy costs and energy intensities. At an average 6570 megajoules/tonne of processed raw fibre, however, energy conservation is seen as one of the important means of adding to marginal operating profits. Energy costs still amount to about 20% of the total manufacturing costs in this sector.

Housekeeping and maintenance and minor heat recovery projects are the mainstay of energy conservation programs in this sector.

The British Columbia company is totally dependent on distilled fuel oil for its energy needs including generation of electricity for the mill and town site. The Quebec companies' energy split has been a constant 35% for electricity, 42% from residual fuel oil and 23% for vehicle operation for the past decade.

Cement Manufacturing

The rate of improvement faltered at 0.6% during 1988 because most cement plants were operating at maximum capacity. In previous years, average increases of two to three times this rate were achieved as capacity utilization levels kept rising. Energy consumption per unit of production has improved a total of 22.6% compared with the 1974 base year level.

A total of eighteen gray clinker cement plants, producing 10,715 equivalent tonnes[2] by the wet-process (21.9% of the total) and dry-process (78.1%), are represented in this survey. Future capacity and operating efficiency will improve in 1989 when a new 5000 tonnes per day state-of-the-art enlargement is completed in a plant near Toronto, as well as expansions in a Montreal area plant.

[2] An equivalent tonne is a weighted measure of production that accounts for the different energy intensities required to make clinker and cement. In most "balanced" plants, 85% of the energy is used to make clinker and 15% used to make cement. In this survey, the weighted average is proportioned 92% for clinker production and 8% for cement production.

Significant improvements in some of the wet-process plants were achieved during 1988, with the result that average energy intensity fell to 5,777 megajoules per equivalent tonne from 6,093 MJ/E.T. in 1987. Wet-process plants consumed 6,501 MJ/E.T. in 1974 when monitoring began.

By comparison, the inherently more efficient dry-process plants (with no preheater) saw a loss of efficiency when average energy intensity rose from 4,472 MJ/E.T. in 1987 to 4,620 MJ/E.T. in 1988. Plants with preheaters managed to increase efficiency 0.6% to 4,598 MJ/E.T. during the year.

Total cost of fuel and electricity amounted to $181 million which usually represents about 23% of total manufacturing costs. Energy efficiency improvements alone, since 1974, are now saving the cement manufacturers some $94 million each year, at current energy prices.

Some very dramatic shifts in energy sources (ignoring efficiency gains and process changes) have occurred since monitoring began in 1974. For example, the net electrical intensity has risen from 138 kWh/cement tonne in 1974 to 147 kWh/cement tonne in 1988.

St. Lawrence Cement Inc. in Mississauga has been conducting refuse burning studies for the past 4 years to gather the necessary data for environmental approvals and large-scale project development. Cement kilns are ideally suited for disposal of most municipal and some hazardous wastes. In fact, 100% of Canada's combustible wastes could be safely disposed of in the existing domestic cement kilns and thereby reduce conventional fuel consumption by 47%.

Clay Brick, Tile, and Clay Products

Even though the basic brick making process is 5000 years old, technological advances are still being made in this industry.

In the surveyed companies, while mixed performances resulted in a 1.4% increase in energy consumption per unit of production during 1988, overall performance is still 27.9% better than it was in 1978 when monitoring began. Where efficiencies slipped, it was generally in those companies beginning to experience lower capacity utilization rates caused by slowing construction markets. In this sector, energy costs often amount to 25% of total manufacturing expense. Careful scheduling of production is therefore important to maintain production efficiencies and inventories at their best levels.

The energy intensity of clay brick manufacturers now averages 3585 megajoules/tonne (1.8 tonnes/1000 equivalent units) while the energy intensity of short run clay tile producers is often three times this amount.

Several companies report continuing heat recovery improvements and gains from computerizing burner controls on their kilns. Some mentioned scheduling production on their most efficient equipment as a significant energy efficiency control technique. Electrical systems are still being improved by installation of additional capacitors and demand peak controllers.

Fuel and electricity would have cost $6.5 million more during 1988 if there had been no efficiency gains since 1978. This saving is based on the total energy cost of about $15 million and overall efficiency gains achieved to date. Three-quarters of this cost saving has been achieved by more efficient combustion of natural gas and/or heat recovery while one-quarter of the savings have come from improvement in the electrical power systems.

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Natural gas has completely replaced the use of fuel oil in this sector. Now, the cost share of natural gas has risen to 79% of the total energy expense, while electricity, using only 7% of the total consumption, accounts for 21% of the overall cost. Most companies in this sector are benefitting from deregulated natural gas contracts.

Concrete Products

The concrete products sector is a diverse manufacturing group that make concrete blocks, sewer casings, precast slabs, and a host of miscellaneous products for the construction industry. It is a moderately energy-intensive operation requiring about one-tenth of the energy used to make cement. Concrete blocks, for example, generally require 350 to 500 megajoules per tonne of product, depending on the type of curing system used.

While overall energy utilization is 15.9% better than it was in 1979, there was no noticeable gain recorded in 1988. The mix of energy use in this group reflects the large yard materials handling activities, e.g. 5% for plant electrical use compared with 23% for diesel vehicles. Over two-thirds of the total energy mix comes from natural gas used to generate steam for the curing autoclaves.

In recent years, energy management attention has concentrated on lowering natural gas costs, primarily by negotiating the best prices available.

Glass

The 5 companies surveyed in this sector operate 19 large continuous glass making plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada.

Tough competition and poor markets, made worse by provincial government Container Act policies, have caused some rationalization of container product furnace operations during the year. Glass melting furnaces and processing equipment have a very limited turndown range and must completely shutdown to avoid gross inefficiencies.

Fuel and electricity cost this group $99.5 million in 1988. Energy utilization gained 2.1% in 1988 which raised the total to 35.9% over the original 1974 base year reference values. In so doing, the participating companies are saving $34 million per year due to various operating improvements.

Even though the cost and energy consumption mix is moderately different among reporting companies because of their various end products, the net effect of the energy substitutions has resulted in significant savings. For example, the electrical consumption share rose from 9.4% in 1979 to 18.4% in 1988 while its share of total costs went up from 27% to 43%.

Over the same period the natural gas cost share shrank 27 points (from 78% to 51%), while consumption declined only 7 points (from 84% to 77%). Clearly, companies' bottom line benefitted from deregulation in natural gas markets. A smaller reduction (8% to 6%) in fuel oil consumption also helped lower annual energy costs.

Most glass making applied R&D efforts are being concentrated on fusing the raw materials directly inside special burners. This technique provides quicker melting, reduced furnace residence time, and operation of low-excess air combustion systems. Tests also continue on use of recovered waste heat for preheating cullet feed (up to 1,100°F) to reduce the need for electric boosters.

Most of this sector's energy savings have been achieved by modifications to the glass melting furnaces, i.e. optimum cycling of regenerative combustion systems, repositioned burners, more effective insulation systems, etc. Significant savings have also been achieved from better heat control in the different annealing oven zones.

Glass plants are now installing modern real-time data acquisition systems to provide the heuristic data for more effective control systems as well as daily accounting of operating efficiencies and utility costs.

Because glass making is a very energy-intensive operation requiring about 4.7 gigajoules per tonne for the melting operation alone, energy management remains a routine activity throughout this sector.

Lime

The companies reporting in this group make various grades of lime and cement, and process a number of dolomite products for fluxing, refractory and chemical use. Lime is made by calcifying quarried limestone at 265°F in rotary kilns. Lime manufacturing now requires an energy rate of about 6300 megajoules/tonne, which often amounts to 40% of total manufacturing cost.

Energy efficiency improvement slowed to half the usual 1.2% per year gain because most of the benefits from kiln upgrading projects and gains from high capacity utilizations have already been realized.

While some lime kilns are fired with coal, natural gas is the preferred fuel when high product purities are essential. Among the surveyed companies, coal consumption has represented about 12% of the total mix for the past 6 years. Use of fuel oil has been reduced from 32% to almost nil since 1979, while the natural gas share has risen from 52% to 80%. Lime making and processing is a low hydro intensive operation requiring less that 6% of the total energy consumption mix. Even so, the proportion of electrical costs has risen from 7.5% in 1979 to 12.5% in 1988.

Miscellaneous Minerals

This diverse group of companies produces a variety of products such as silica sand and nepheline for glass making, raw crushed limestone and gypsum products, roofing granules, and sodium sulphate. Many of these products require extensive crushing and pulverizing, milling, refinement, drying and grading operations run on intermittent time schedules.

Group performance slipped 1.9% in 1988, largely because capacity utilization started to decline from previous high levels in many of the surveyed companies. This leaves the overall improvement at 11.8% over the 1977 reference values.

For the current reporting group, 38% of total energy is provided by electricity, 47% by natural gas, 9% by vehicle fuels, and 6% by coal. Use of electricity has steadily grown during recent years. Additional use of natural gas has offset the 20% drop in consumption of fuel oil since 1979.

Electrical systems continue to receive the most attention with general overhauls, installation of peak demand controllers, and replacement of old process equipment. Some companies are taking advantage of extended downtimes to make these extensive improvements. Replacement of rotary dryers with more efficient fluidized bed dryers is also in progress.

Refractories

Meaningful performance information is difficult to aggregate because there has been a significant change in product mix in this small sector. What's more, many of the companies are reluctant to divulge too much data because of tough domestic and growing international competition.

However, companies are quick to note their "high" priority concerns for energy conservation. Most companies in this group have had up-to-date technical audits conducted and have also investigated the latest electrotechnologies.

Average fired product energy intensities are in the 6500 megajoule/tonne range and energy costs usually represent about 40% of manufacturing expenses. Approximately 85% of this energy is supplied by fossil fuels, which can be either natural gas or fuel oil, depending on the location of the company. Sufficient reporting has been done over the years to indicate that process efficiencies have been improved by 10.5% since 1975. Based on the reporting population's energy consumption, fuel and electricity cost some $4.6 million.

Table I

Industrial Minerals Industry
Energy Consumption and Cost

Sector	Consumption Terajoules	Eff. % Gain	Total Eff. % Gain	1990 Target	Base Year	1988 Est. Cost ($,000)	1988 Savings ($,000)
Abrasives	3,202	– 0.86	10.4	20	1982	36,359	5,843
Asbestos	5,154	3.81	15.8	10	1979	46,169	9,406
Cement	51,622	0.64	22.5	40	1974	181,118	94,207
Clay Brick	3,584	– 1.43	27.9	40	1978	15,000	6,540
Concrete Products	637	– 0.24	15.9	20	1979	4,017	1,162
Glass	18,569	2.15	35.9	50	1974	99,586	33,888
Lime	4,714	0.60	17.8	25	1979	25,608	8,602
Miscellaneous	2,875	– 1.90	11.8	15	1977	21,026	5,246
Refractories	961	0.04	10.4	15	1975	4,605	1,754
Totals	91,318	0.65	27.8	35	1975	433,488	166,648

Table II

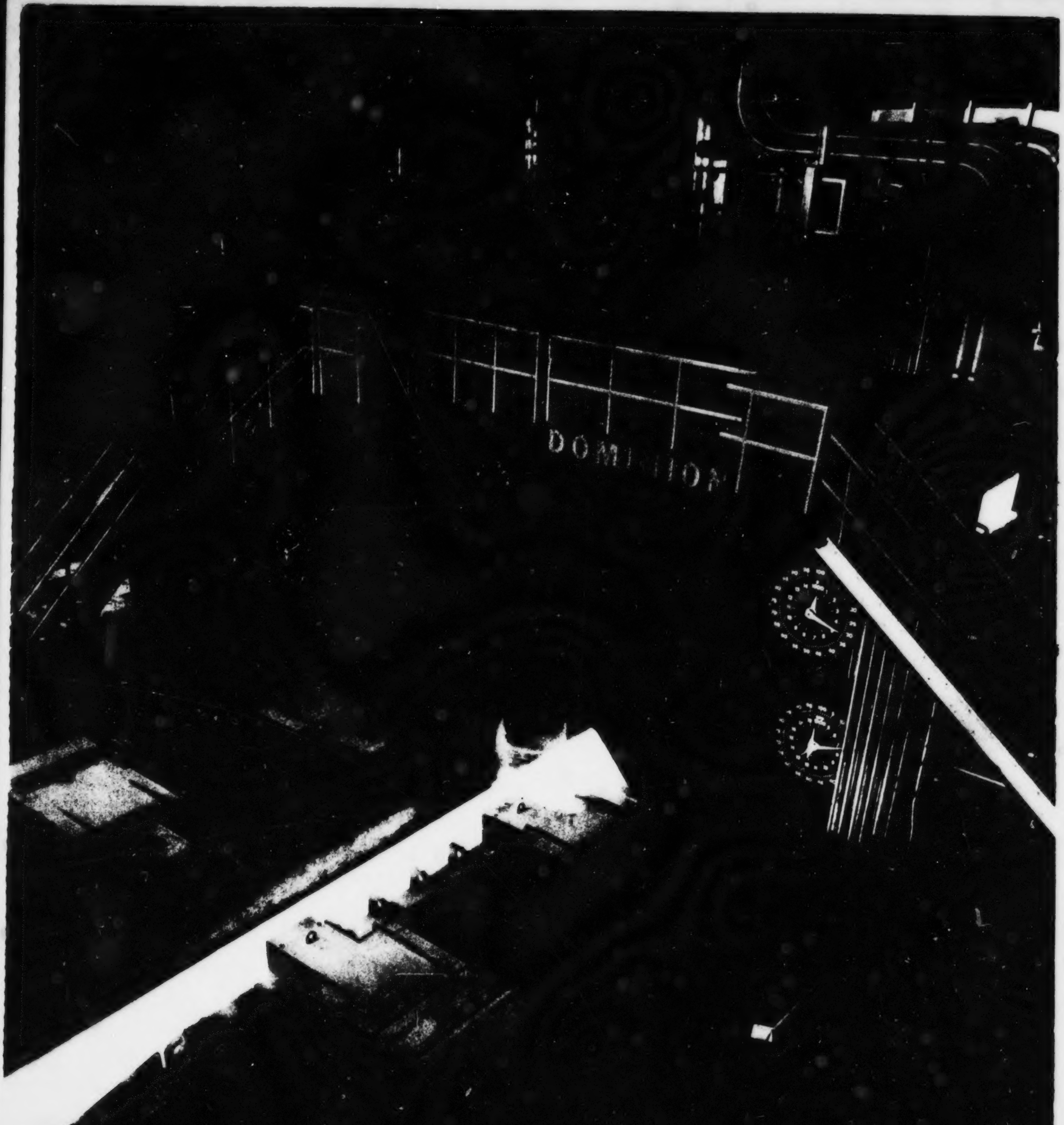
Industrial Minerals Industry
Energy Use and Efficiency

Type	Units	Petajoules (10^{15})	Distribution %		
			1988	1987	1979
Natural Gas	956,886 m^3	35.596	39.0	42.7	44.9
Electricity	4,216,848 MWh	15.180	16.6	15.5	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	14,474 kL	0.565	0.6	0.6	2.7
#6 Fuel Oil	85,054 kL	3.445	3.8	4.0	14.5
Diesel & Gas	60,826 kL	2.412	2.7	2.0	7.4
Coal	10,300,000 T	33.063	36.2	34.0	15.8
Other Fuels:					
Propane,LPG	9,642 kL	0.257	0.3	0.2	0.2
Steam	—	0.800	0.8	1.0	0.6
Total	1988	91.318			
	1987	91.262			
	1986	82.632			
	1985	80.081			
	1984	79.217			
	1983	74.291			
	1982	84.229			
	1981	100.403			
	1980	98.615			

1985 Base Year Equivalent Consumption = 93,533 Petajoules

Efficiency Improvement to 1985 = 25.4%
in 1986 = – 0.3%
in 1987 = 2.0%
in 1988 = 0.65%

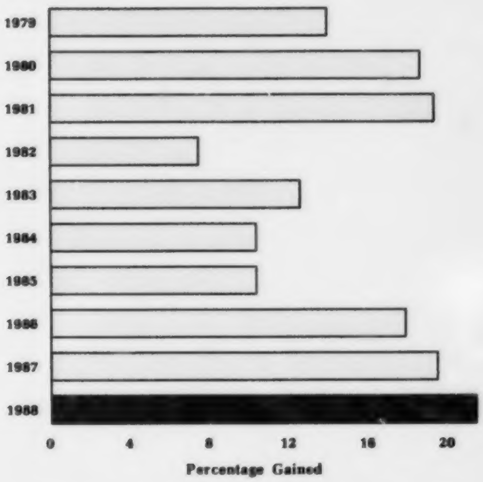
Total Improvement = 27.7%


DOMINION

Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The energy consumption and trends contained in this report are based on the results of a survey conducted by the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). MEMAC member firms manufacture a wide spectrum of plant, mill and field equipment used by all resource and manufacturing industries, ie., machinery and equipment which is used in public utilities, in steel mills, in automobile factories and in the mining and forestry industries; the pumps, valves, compressors and drills used by the petroleum and construction industries and products such as conveyors, cranes, packaging and printing machinery, which are utilized by a number of industries.

The survey covered approximately 100 firms, including several non-members. The response rate was 31%. The majority of firms are located in Ontario and Quebec.

General Performance and Progress

The participating firms reported an aggregated energy intensity improvement of 1.7% during 1988. This result means that the sector has improved 11.1% since the new 1985 base year level, and 21.5% since the machinery industry joined the program (see Table 1). The industry has already reached its goal of 15% by 1990.

The factors that contributed to this success are many and are impossible to quantify. The probability of the Canada/U.S. Free Trade Agreement, for example, has prompted firms to rationalize production, and energy utilization may have shifted elsewhere rather than being attributable to improved energy efficiency. Furthermore, the overall economic improvement in this sector of the industry since the mid-1980's has allowed firms to invest in new plant, equipment and processes which have increased productivity and improved energy efficiency. In addition, firms are sub-contracting work to specialized shops which may distort the measurement of energy utilization. New materials and processing techniques also contribute to improved energy efficiencies. The one certain factor is that each firm, in its own way, addresses energy efficiency as it develops its strategic plan.

Task Force Activities

No new major MEMAC initiatives are planned for the immediate future but the industry will continue to work with both federal and provincial authorities to ensure that energy management programs continue to have a high profile. We intend to work with other agencies which have been successful in promoting energy conservation. For example, the auditing programs of the Quebec and Ontario governments will continue to be recommended to members. We will also take advantage of the highly effective and visible advertising programs of Ontario Hydro. These programs are well

Photo – Hot Strip Mill
Dofasco Inc.

received by members because they offer a practical way to improve the efficiency of energy utilization.

In conclusion, this sector has achieved its 1990 goal and will continue its efforts to reduce energy costs. It is recognized that improved operating efficiencies are essential if Canada is to maintain its level of productivity and competitiveness in the global economy. It is expected that the greatest potential for additional energy efficiencies will be through the use of new materials and innovative manufacturing techniques.

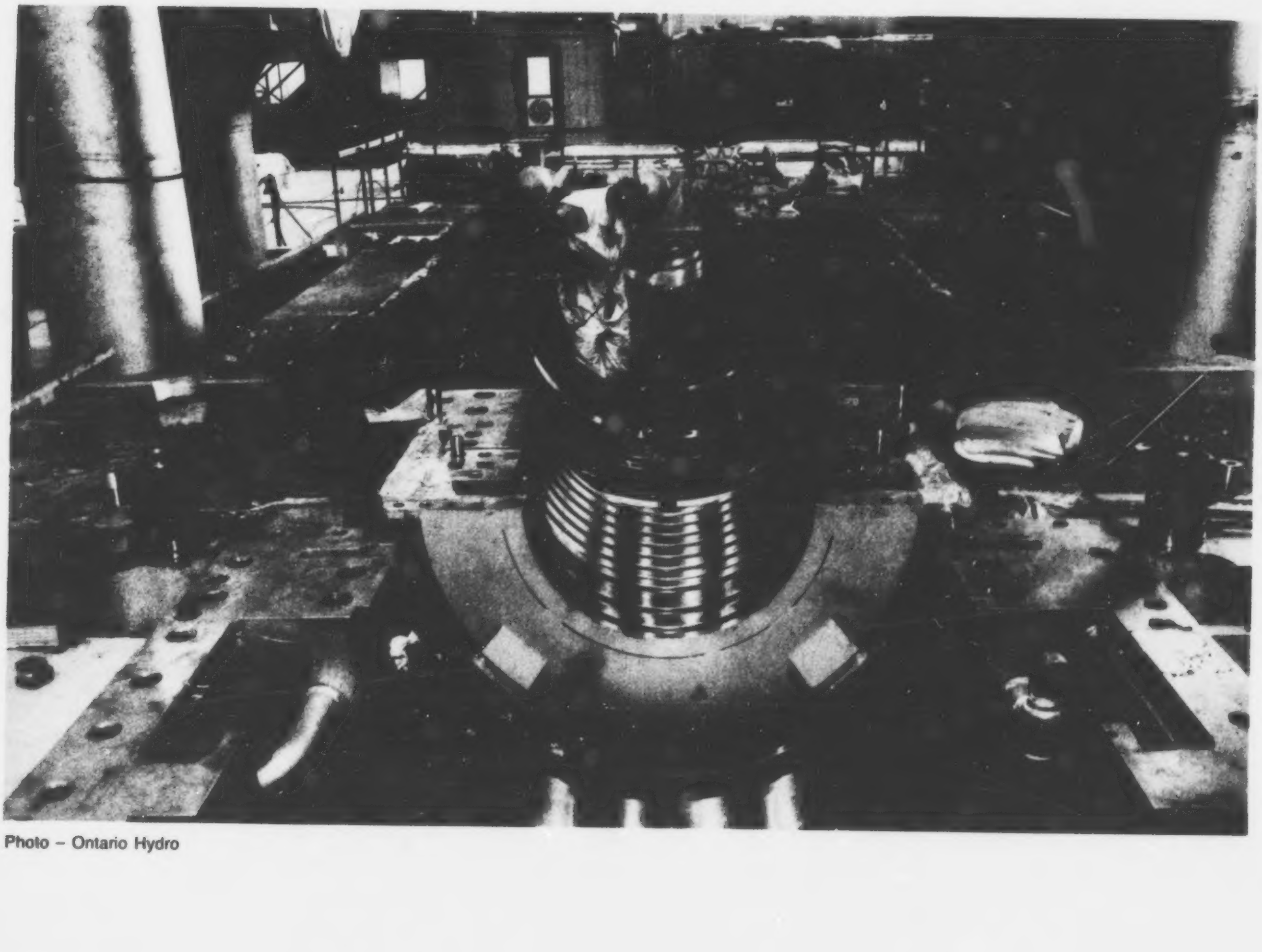


Photo – Ontario Hydro

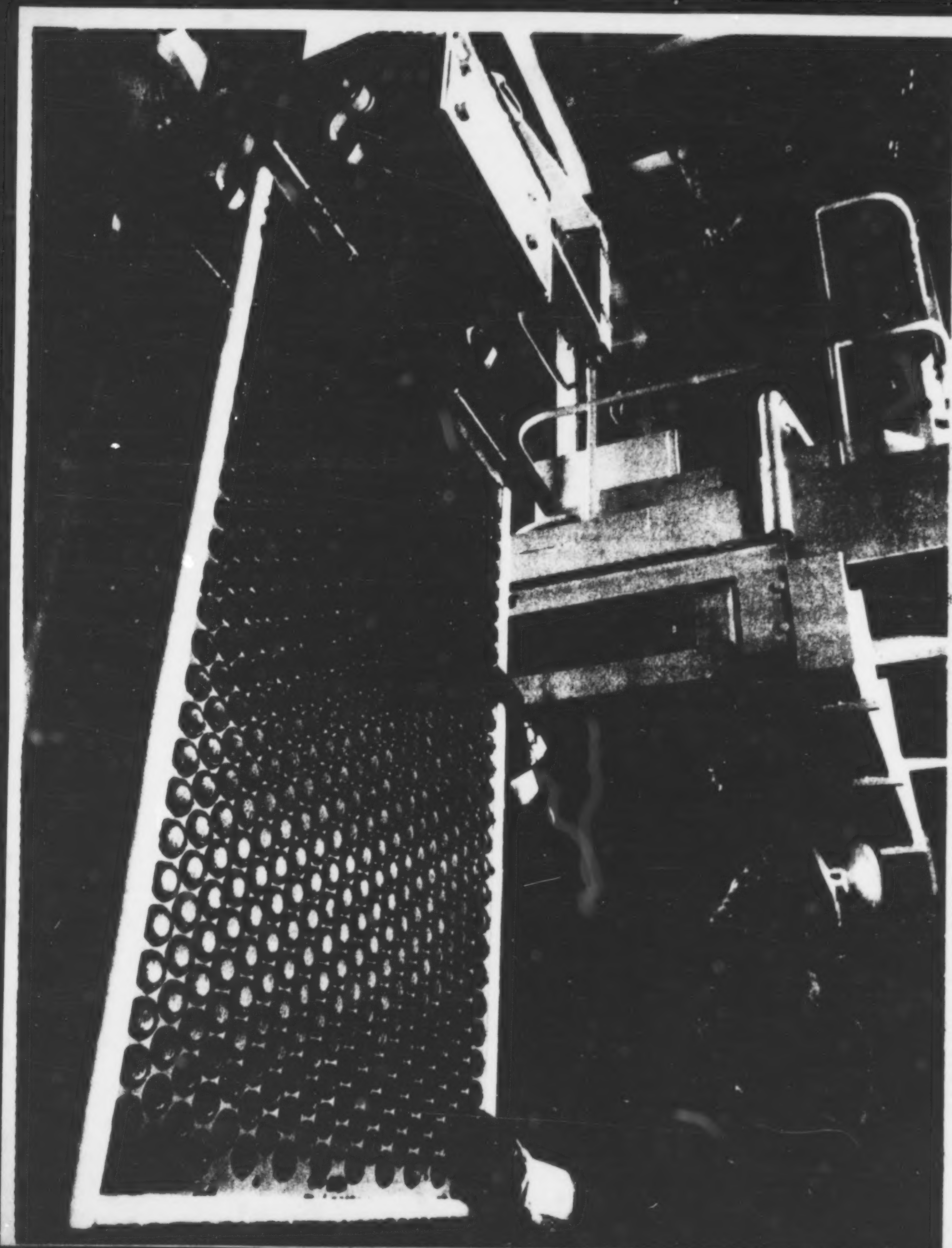
Table I

Machinery Industry
Energy Use and Efficiency

		Gigajoules	Distribution %	
Type	**Units**	**(10^9)**	**1988**	**1985**
Natural Gas	9,128,522 m^3	339,581	52.6	36.7
Electricity	69,587,235 kWh	250,514	38.8	41.3
Liquid Petroleum Products:				
Distillate Oil	1,016,551 L	39,646	6.1	8.8
Crude Oil	40,000 L	1,608	0.2	10.5
Diesel	10,362 L	413	0.1	0.1
Gasoline	223,185 L	8,079	1.3	1.3
LPG	36,764 L	996	0.2	0.4
Other Fuels:				
Propane	179,453 L	5,049	0.8	1.0
Total	1988	645,886		
	1987	566,274		

1985 Base Year Equivalent Consumption = 726,531 Gigajoules

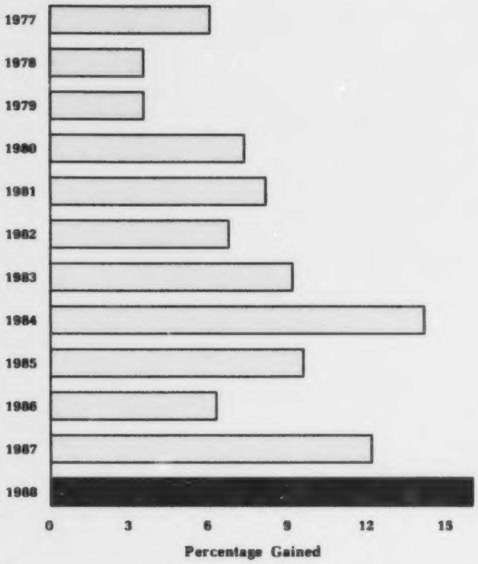
Efficiency Improvement 1975-1985 = 10.4%
in 1986 = 7.5%
in 1987 = 1.9%
in 1988 = 1.7%
Total Improvement = 21.5%



Mining and Metallurgy Industry

Energy Conservation Task Force

Jean Gilles Girard
Chairman



Task Force Description

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Its membership includes the major Canadian producers of iron, copper, nickel, lead, zinc, gold, silver, aluminum, molybdenum, uranium, synthetic oil and fertilizers. A number of energy-intensive processes are used including milling, smelting, indurating and electrochemical refining.

A total of 13 major integrated companies participated in the 1988 survey. These companies operate a total of 26 mine sites in addition to the associated processing operations. Some 80-85% of the total Canadian mining industry output is represented.

The task force continues to focus on technology transfer activities by providing technical seminars and case study literature to its members.

Performance

The participating companies had an aggregate 3.7% improvement in energy intensity over 1987, raising the total gain of 16% since 1973. The 1990 target of 15% has thus been surpassed two years earlier than forecast. A new target will be established for 1995.

The value of the energy consumed was estimated to be $905 million. However, the 1988 energy bill would have been $35 million higher if the 3.7% improvement in energy efficiency had not occurred.

In the mining industry energy efficiencies are very sensitive to changes in output, as shown in Figure 1. This graph compares the annual growth rate of GDP and the improvement in energy intensity. Energy efficiency gains are usually a few percentage points below the annual GDP growth rate. However, during the 1981-1982 recession this relationship reversed because companies made extra efforts to maintain production efficiencies.

Energy Use Patterns

There was no discernable change in the distribution of energy shares between 1987 and 1988. The trends over the past decade are presented in Figure 2. During the period natural gas consumption has slowly replaced the use of petroleum products. This was brought about by the oil price shock of the 1970's and deregulation of the natural gas market in 1985 which reduced prices. Electricity's share of total costs has risen from 56% to 63%, despite the fact that its share of total consumption has fallen marginally in favour of coal.

The task force's energy distribution figures cover a variety of processes. A more detailed breakdown is provided as noted on table I[1].

Table I

	Task Force 1988	Mining & Milling	Smelting & Refining
Electricity	34.5	36.7	16.9
Fuel Oil[2]	15.7	20.4	8.1
Natural Gas	40.5	37.8	47.5
Coal	8.6	2.0	27.4
Other[3]	0.7	3.1	0.1
	100.0	100.0	100.0

[2] Diesel, kerosene, light fuel oil and heavy fuel oil.

[3] "Other" includes gasoline.

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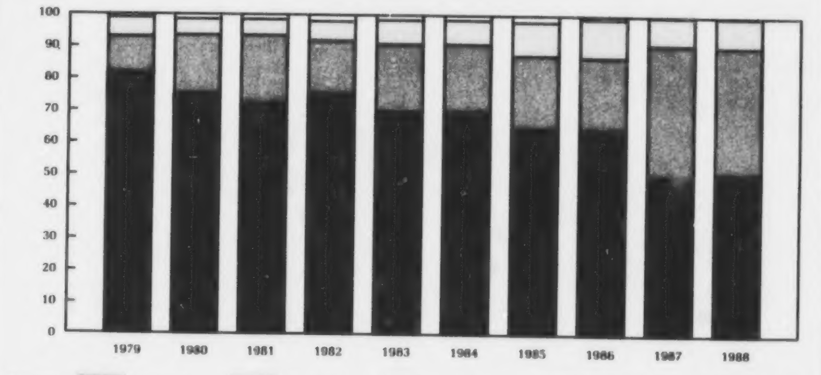
[1] Acres Consulting Services Ltd., "Ontario Industrial Energy Demand Study", Ontario Ministry of Energy, 1980.

Photo – Cobalt Refinery Tank House
Inco Limited

Figure II

Mining and Metallurgy Industry
Historical Energy Distribution



The huge potential for energy recovery from heating, ventilating and air conditioning (HVAC) equipment receives on-going study in the mining industry. Compared to other countries' mines of equal depth, Canadian underground mines are generally cooler and experience some heating load in the winter months. At a few locations glycol loop systems recover waste heat from exhaust ventilation air for use in the shaft house, an adjoining office or, in one case, in a greenhouse.

There are many sources of underground mine heat such as: heat from uninsulated compressed air lines or hot water lines, evaporation from hot rock walls, hot water from underground sources, adiabatic compression of the inlet air down deep shafts, heat liberated by blasting, and friction from moving air. All these sources of heat add to the ventilation and air conditioning loads.

Underground power-operated equipment also transfers large quantities of heat into the mine atmosphere. Heat produced by diesel equipment equals about 90% of the energy content of the fuel consumed, or 35.9 MJ/L. Most mines have switched to electric drive vehicles or electric-hydraulic systems which release only one-third to one-half the heat given off by diesel powered equipment. At the same time ventilation demand is reduced.

One mine satisfies part of its cooling load by spraying water on rocks surrounding the intake shafts during the winter months to make ice. In summer, intake air is cooled by drawing it over this ice. This is the least expensive way of cooling a mine in the summer. Underground cooling plants are often used in deep mines close to the work area, but expensive electricity is consumed pumping cooling water to the surface.

There is a significant potential for on-site generation of electricity as there is a demand in the smelting and refining processes for both vast quantities of electricity and process heat. Processes where electricity is consumed include the mining and milling of ore; the smelting of base metals such as nickel, copper, and zinc using electric "submerged-arc" furnaces; and the electrolytic refining of these metals. Large quantities of heat are used in the roasting phases and reverbatory or flash type furnaces which burn fossil fuels.

Falconbridge Limited, located in Sudbury, Ontario, is currently participating in the joint Ontario Ministry of Energy/Ontario Hydro "Energy Monitoring Demonstration Program". The system being installed features approximately 127 meters measuring electricity, natural gas, hot water and compressed air use. The system consists of an industrial minicomputer at each of five locations. One computer receives summary data from the other four and provides overall system co-ordination as well as controlling peak and off-peak electricity use. It is expected that the system will help optimize the production processes and minimize specific energy intensities.

Future Outlook

1988 was a good year for producers of primary metal products. Production gains were widespread, with increases recorded in smelting and refining of gold, nickel, silver and aluminum. Exports of all refined minerals except copper increased. Gold mines increased production by 15% in 1988 following gains of 15% in 1987 and 25% in 1986. Three major new mines started operations in December 1988. Iron ore mines recorded a 10% rise in output, reflecting increased shipments of about the same magnitude to both U.S. and Canadian steel mills. Higher output levels require longer production runs and provide the opportunity to fine-tune processes. Energy efficiency results, therefore, usually advance along with surges in activity.

The Canadian mining and metallurgy industry posted significantly higher profits in 1988 following the recovery of base metal prices. But none of the extra income will go toward increasing capital expenditures. Spending intentions for 1989 on construction, machinery and equipment indicate a decline of 6.4% in 1989, from $2.54 Billion to $2.38 Billion. Repair expenditures are expected to increase marginally from $1.75 Billion to $1.8 Billion.

Table II

Mining and Metallurgy Industry
Energy Use

Type	Units	Terajoules	1988	1985	1980
Natural Gas	1,472,634 km³	54,782	40.5	23.1	18.6
Electricity	12,962,778 MWh	46,666	34.5	41.2	39.6
Liquid Petroleum Products:					
Distillate Oil	138,744 kL	5,411	4.0	4.4	6.1
Residual Oil	172,671 kL	7,304	5.4	15.6	27.1
Diesel	203,409 kL	8,116	6.0	4.0	2.1
Gasoline	11,215 kL	406	0.3	0.3	0.3
Coal	151,713 tonnes	4,870	3.6	4.9	2.0
Coke	290,257 tonnes	6,763	5.0	5.0	2.5
Other Fuels:					
Propane, LPG	25,413 kL	676	0.5	2.1	1.2
Others (hot water, steam)	n/a	271	0.2	0.2	0.5
Totals	1988	135,265			

Table III

Mining and Metallurgy Industry
Energy Efficiency Improvement

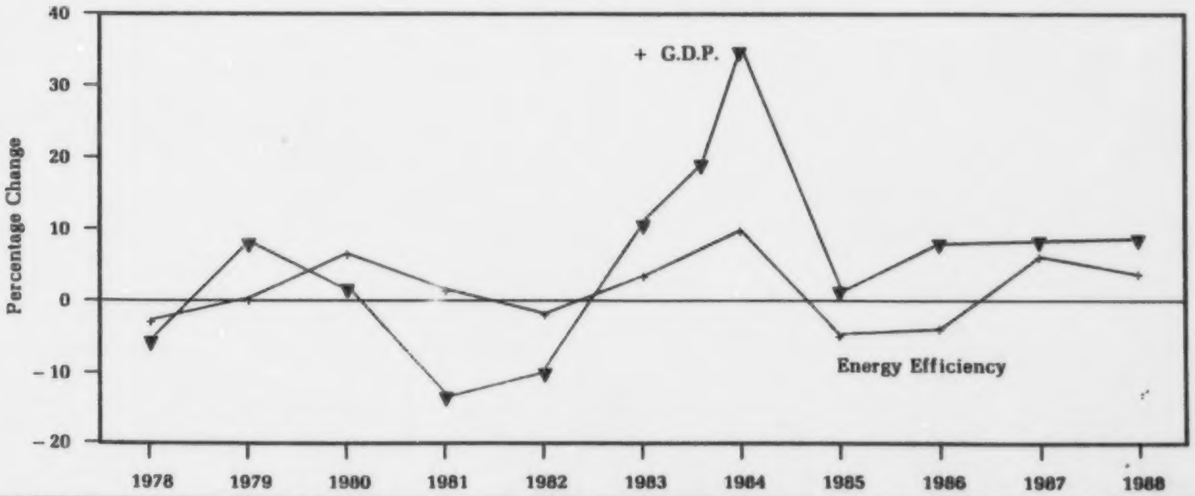
Current year (1988) total energy inputs	135,265 terajoules
Base year (1985) equivalent energy inputs	143,647 terajoules
Adjustments (1985-1988)	882 terajoules

Net Improvement = 6.4%

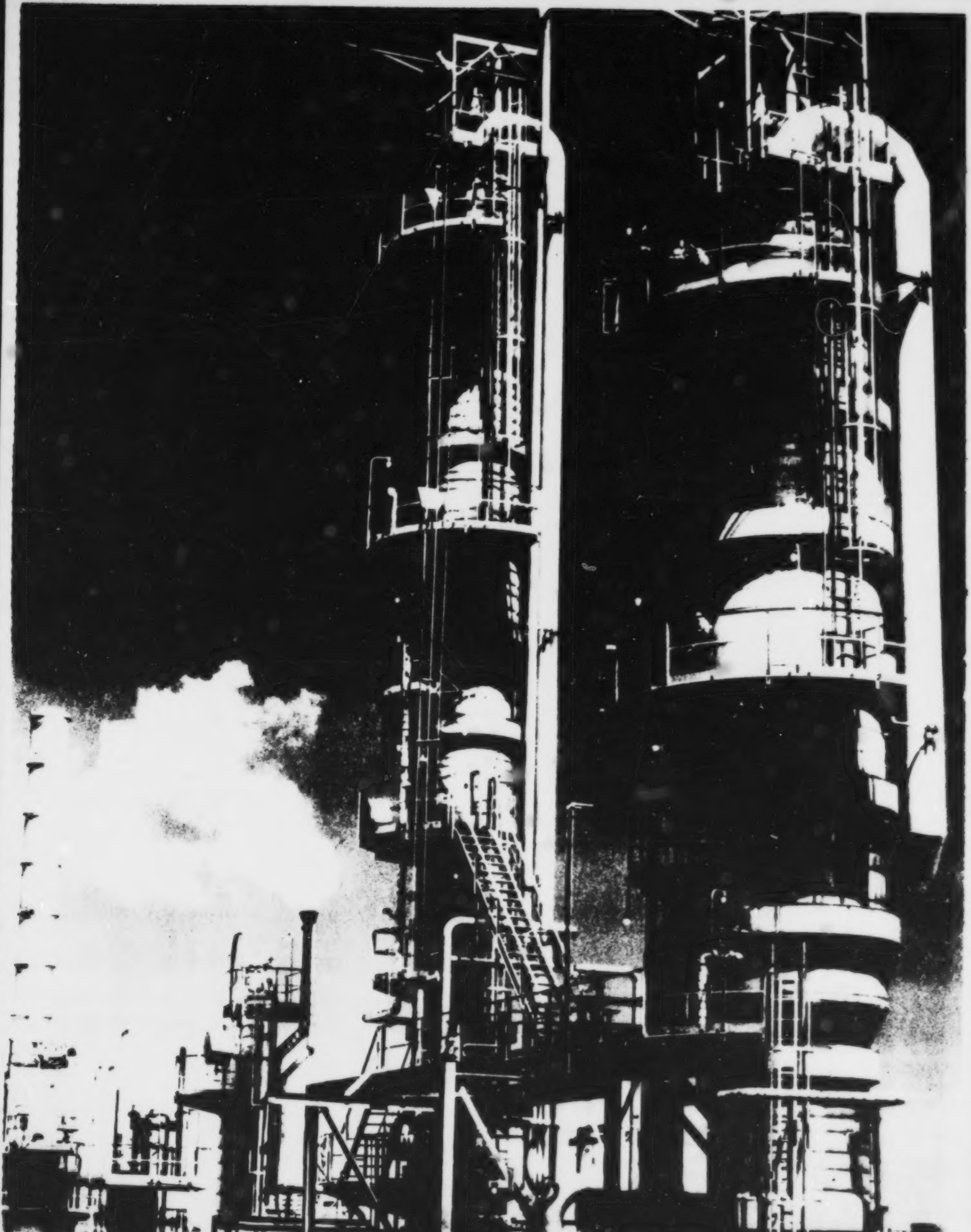
Efficiency gain 1973 - 1985	9.6
1986	−3.3
1987	6.0
1988	3.7
Total gain 1973 - 1988	16.0%

Figure I

Mining and Metallurgy Industry
Annual Rate of Growth



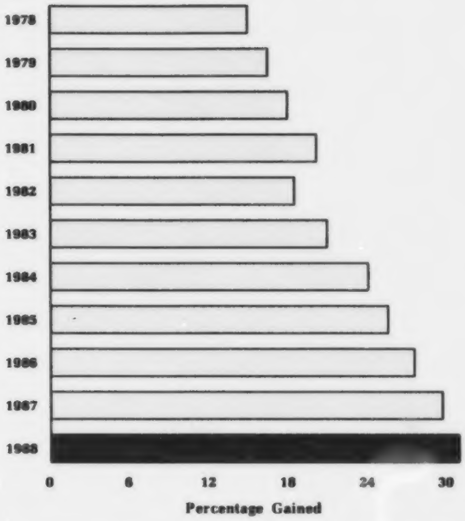
Source: StatsCan 15-001, CIPEC Reports.



Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force established in April 1977 is continuing in the role of reporting on energy conservation progress in its sector. This report for 1988 is based on submissions from 10 companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and in the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference. For consistency, the energy reduction since 1985 has been added to the 25.6% reduction achieved earlier during the period between the original base year (1972) and the new base year.

Energy Efficiency Improvement Progress

In 1988, the petroleum refining industry achieved a 5.7% net reduction in energy consumption relative to 1985. Compared with the original base year of 1972, the improvement is 31.3%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was 4.7%.

Economic Factors Affecting the Industry

Most of the major energy conservation projects derived from process studies conducted in the early 1980's were completed by the end of 1988 and only a few large projects offering rapid returns on investment are planned for implementation in the near future. Continued volatility in crude oil and produce prices is complicating investment decisions regarding energy conservation and other projects. Until refining margins improve further, additional reductions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy, and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance

   The reduction in energy use achieved in 1988 resulted partly from recently completed projects and partly from continued improvement in operating and maintenance practices. Energy conservation equipment installed in the mid-1980's reached the time of requiring additional

Photo – Naphtha Specialties Unit, Sarnia
Imperial Oil Limited

maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Continued emphasis on training operators and engineers;
- Increased furnace efficiency through combustion control improvements;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

2. Capital Projects

Some capital investment in energy conservation work occurred in 1988, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers;
- Improvements in plant automation and control;
- Insulation upgrading;
- Reduction in steam consumption;
- Modifications to raise furnace and boiler efficiencies;
- Facilities to reduce fuel gas production.

3. Technology Improvements

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine crude oil are complex and the improvements easiest to implement were among the first to be installed. Accordingly, the industry has a strong interest in applied research and development to attain higher process efficiency. The industry maintains close relationships with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives;
- Facilities to reduce crude oil and product losses;
- New techniques to increase heat recovery;
- Techniques to convert fuel gas components into liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data management systems;
- Use of high efficiency electric motors;
- Facilities for plantwide monitoring and control of electrical power;
- New types of on-line analyzers;
- Flare gas measurement and recovery.

Task Force Activities

The petroleum industry task force is led by two committees; a steering committee which sets policy, maintains government relations and establishes funding, and a technical committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report. The Steering Committee is chaired by G.G. Myers, and the Technical Committee is chaired by N.J. Little.

To protect the confidentiality of data from individual sources, the offices and secretarial services of PACE are used to obtain and consolidate the technical data submitted by the participating refining companies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technical advances will continue to receive the strongest emphasis in the near term, and should yield appreciable additional improvements in energy use. In Ontario, introduction of time-of-use electricity rates is forcing development of steps to shift some electrical loads to the low cost night time period.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. The highly competitive nature of the industry and the need to remain competitive will likely spur the drive toward higher energy efficiency.

Table I

Petroleum Refining Industry
Energy Efficiency Improvement

Current year (1988) total energy inputs				293.4 petajoules
New base year (1985) equivalent energy inputs				307.8 petajoules
Gross Improvement	1985 to 1988	4.7%		
Adjustments — (for increased processing severity, changes in product mix, capacity utilization, etc.)				3.2 petajoules
Adjusted base year equivalent				311.0 petajoules
Net Improvement	1985 to 1988		5.7	
Efficiency gain	1972 to 1985		25.6	
Total gain	1972 to 1988		31.3%	

Table II

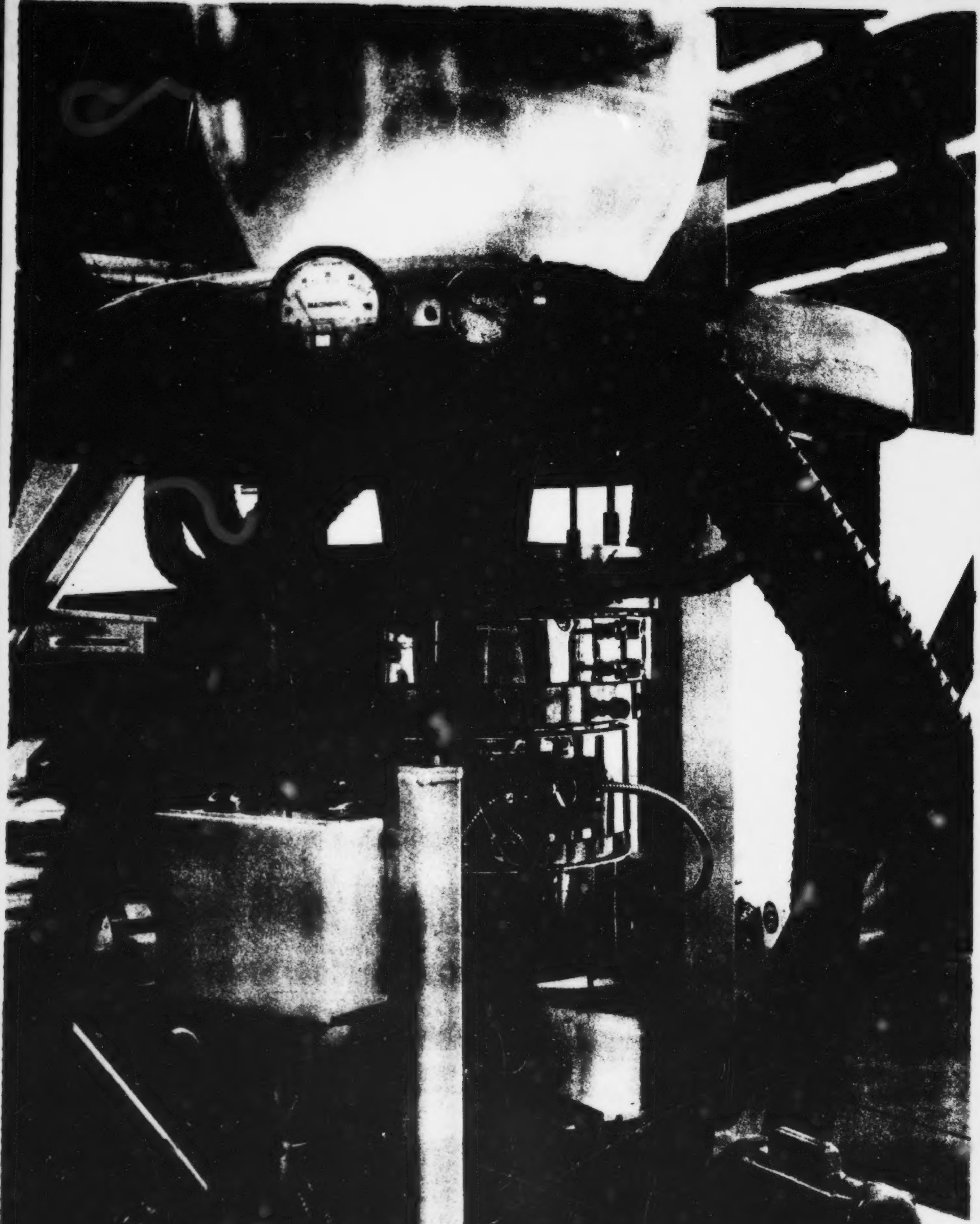
Petroleum Refining Industry
Energy Used in 1988

Type	Petajoules	Percent
Natural Gas	47.8	16.3
Electricity (purchased) (a)	41.3	14.1
Liquid Petroleum Products:		
Distillate Oil	—	—
Residual Oil	18.5	6.3
Petroleum Coke	59.0	20.1
Other Fuels:		
LP Gas	1.2	0.4
Refinery Gas	124.4	42.4
Steam (purchased)	1.2	0.4
Total	293.4	100.0

Energy based on (1) company assigned values, (2) measured thermal values, or (3) U.S. Bureau of Mines values as follows:

Applied Conversion Factors

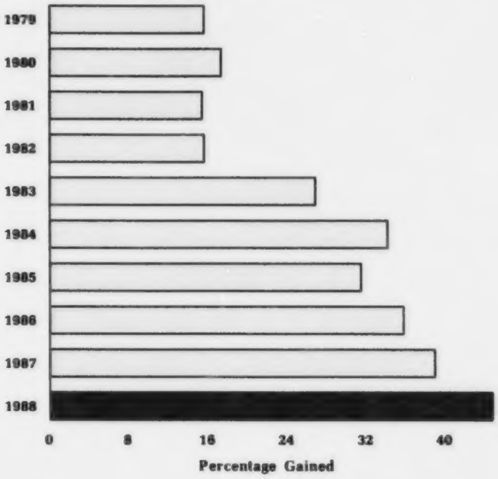
	Crude Oil	37.660 GJ/m^3
	Distillate	38.655 GJ/m^3
	Residual	41.721 GJ/m^3
	LPG	26.617 GJ/m^3
	Natural Gas	38.414 GJ/m^3
	Refinery Gas	36.888 GJ/m^3
	Petroleum Coke	38.030 GJ/kg
	Coal	27.935 GJ/kg
	Purchased Steam	2.791 MJ/kg
(a)	Purchased Electricity	10,551 MJ/kWh



Plastics Processing Industry

Energy Conservation Task Force

Dr. Tom Deans
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada. The group consists mainly of independent extruders, injection and blow moulding operators and film producers. Not included in this survey are the resin suppliers, compounders, distribution companies, equipment makers and a large number of processing operations that are an integral part of other manufacturing industries, e.g., automotive.

The plastics industry is the fourth largest manufacturing industry in Canada with about $11 billion in Gross Domestic Product (GDP) and 78,000 employees. Since 1975, consumption of plastic products has grown by an average 8% per year.

Energy Performance

Energy use per unit of production in the surveyed companies improved 5.5% in 1988, boosting total gain to 13.5% over the new 1985 reference year and 45% above the consolidated 1980 base year. At this rate, the 50% improvement goal set for 1990 should be achieved one year earlier than expected.

It is estimated that the 52 participants, operating some 70 plants, spent $21.9 million for fuel and electricity during 1988. In this mix, the 51% electricity energy share accounts for 77% of total cost. Some plant sites depend solely on electricity, especially in Quebec where marketing incentives provide cost advantages over use of fossil fuels. In these plant sites, electricity is used, not only for motive power, but also for raising steam and process heating.

Natural gas accounted for 44% of the participants' energy consumption and 19% of total energy cost. These energy consumption versus cost ratios reflect mainly the impact of Ontario prices since over one-half of the plastics processing industry is located in that province.

Only minor quantities of fuel oil, amounting to 2% of total energy consumption, are used for a number of different reasons. For some, such as the Maritime provinces, it is the only convenient fuel available. For others, fuel oil can be used only when required without regard for preset (natural gas) contract limits. The main consumption, however, appears to be by larger processors where natural gas interruptible contracts require a backup fuel source.

Rising consumption of electricity in plants, primarily because of increasing production rates, has resulted in less fuel required for heating facilities. In fact, many densely packed injection moulding operations continue to exhaust vast quantities of heat year-round because there is no place to reuse it. In the past 9 years, the electrical energy share in processing plants has grown from 40% to nearly 51% of total consumption. In the same period the natural gas share has dropped from 55% to 44%, with consumption of other fuels remaining essentially stable.

Factors Impacting 1988 Performance

The plastics processing industry continues to experience a relatively high energy efficiency improvement rate for a number of business and technical reasons:

The plastics processing industry is the fastest growing sector in the Canadian manufacturing industry with a recent growth rate of some 8%. Real Gross Domestic Product (GDP) has doubled since 1971. To satisfy this outstanding growth rate, annual capital spending on new construction, and more efficient machinery and equipment has grown from $60 million in 1975 to more than $250 million in 1988. Even higher annual energy efficiency improvement rates would be registered in this fast growing industry if the purpose of the new equip-

Photo – Polyethylene Film Bubble
AT Plastics Ltd.

ment was to replace older inefficient equipment rather than for expansion.

What's more, to help achieve greater production demands, capacity utilization rates escalated from a low of 75% in the 1982 recession to a peak of 100% in late 1987. In 1988, capacity receded slightly to 92% at the end of the year, according to Industry, Science and Technology Canada figures, but general utilization rates nevertheless remain in a highly efficient operating range. In this high utilization situation, continued healthy capital spending is justified and further efficiency improvements will ensue.

The trends shown in Figure 1 reveal that efficiency increases have not kept pace with the growth in production. This may have occurred for a number of reasons. For instance, smaller operators tend to rent factory space from realtors who are not generally concerned about energy efficiency. In other cases, many businesses have grown so fast that obsolete equipment is still being used and/or some equipment is pushed beyond optimum design efficiencies. As well, plastics processing is an endothermic process with varying degrees of plasticizing efficiency and heat loss.

Survey responses indicate that energy is considered a "medium" and "increasingly" important production cost factor. This concern reflects the thinking of the majority of participants who are injection moulders with energy versus manufacturing cost percentages of about 20%. Those using extrusion and blow moulding processes tend to be somewhat less concerned because of lower energy/cost ratios in the 10% to 15% range while film-making and coating operators expect costs in the 8% to 10% range.

Two-thirds of the reporting companies had annual energy costs in the $100,000 to $500,000 range. Many of the firms in this category are able to dedicate equipment to long-running production stretches, have made energy management the responsibility of production or engineering managers, and generally perform some energy monitoring through their cost accounting departments. These are the companies that most often show the highest efficiency improvement and have an "increasing" concern toward energy efficiency.

A growing number of survey participants have energy costs above $1 million because of company mergers, increased production capacity and rising energy prices. Many of these companies employ highly trained plant engineers responsible for energy efficiency and conservation.

Leading processors in this category are starting to take a more thorough look at their manufacturing productivity rates. This is evident in comments made by those in the process of upgrading their energy monitoring systems, some of which are forerunners of real-time data acquisition systems (DAS) and, eventually, to total computer aided manufacturing (CAM) control.

The technical improvements that have resulted in efficiency improvements are sometimes very complex, given the advanced technologies used throughout this industry. Comments from the surveys described basic actions as well as the difficult areas where lucrative savings are being achieved. In the basic category, common remarks were the upgrading of HVAC and boiler operations, lighting, cooling towers, compressed air systems, insulation, steam traps, etc. In the second category, installation of programmable logic controllers (PLC), replacement of gas unit heaters with infra-red heaters to reduce air flows, and installation of high-efficiency motors on older extruders were mentioned.

Since electricity is the dominant expense it is drawing increased attention. From a recent study[1] of consumption in a injection moulding operation, electrical use was distributed as follows:

Injection moulding machine	65.0%
Raw material handling	0.7%
Chillers	5.5%
Cooling Towers	2.0%
Air Compressors	3.5%
Plant Lighting	4.1%
Ventilation	0.2%
Air Conditioning	6.5%
Mould Maintenance	3.4%
Machine Maintenance	3.4%
Secondary Operations	1.7%
Office use	3.4%

Electrical consumption in the injection moulding process varies considerably because of machine design and age, clamping capacities, resins processed, etc. However, the injection screw drive often requires 30% to 50% of cycle input, cylinder heating 10% to 40%, while the hydraulic system accounts for 40%. On the output side, mould cooling often carries away 20% of the converted energy to cooling towers while extruder convection and radiation losses amount to 15%. Overall operating efficiencies of many injection moulding processes are thought to be in the 15% to 25% range.

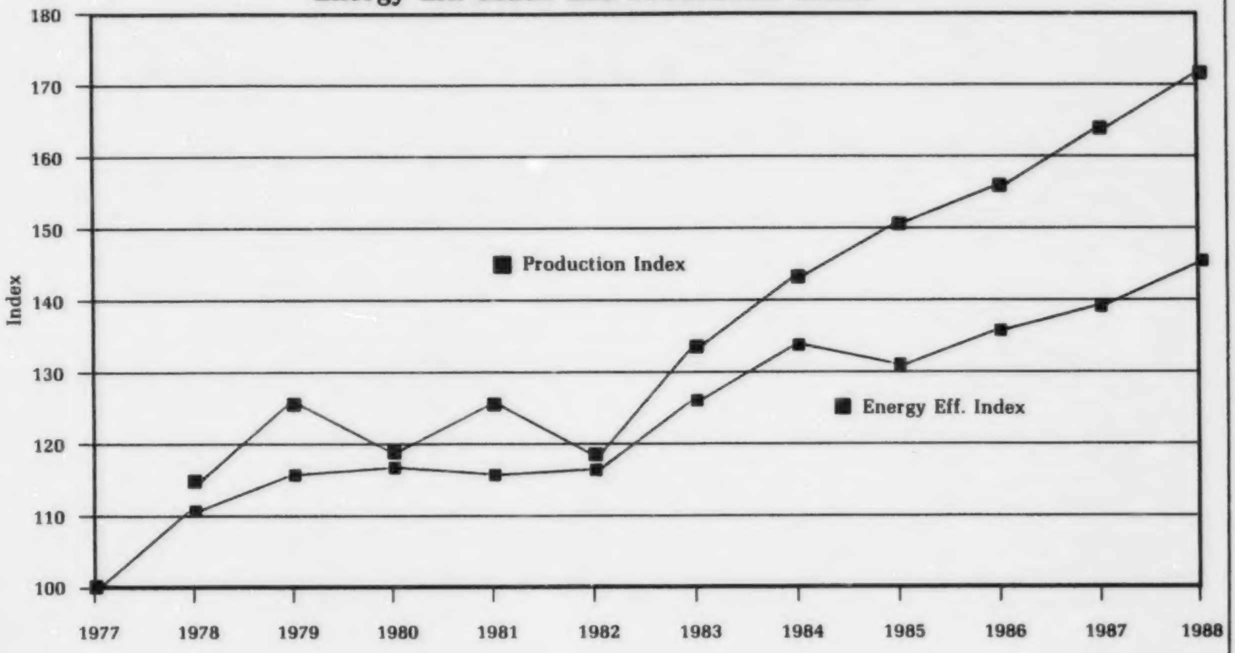
Estimates of efficiencies for the continuous extruding process can be as high as 40% to 60% depending on the resins and nozzle heating systems. Most extrusion manufacturers agree that solid state D.C. direct drives with helical gearing provide the most efficient results.

Canadian machinery manufacturers have made significant efficiency improvements in their designs to stay competitive with manufacturers in Japan and Germany where designs are based on electrical costs that are three to four times higher than Canada's. Installation of microprocessors to sequence machine operation, minimize screw speeds and optimize clamping capacities according to resin quality and cycle times, are fairly common practices. Many operations have become completely automated and only shut down when production quantities are satisfied or maintenance is required.

[1] "Energy Consideration in Planning an Injection Moulding Operation": Rodolfo Selem, Systems Engineer, Husky Injection Moulding Systems Ltd. 1982

Figure 1

Plastics Processing Industry
Energy Eff. Index and Production Index



Source: Statistics Canada #31-003, CIPEC reports.

Table II

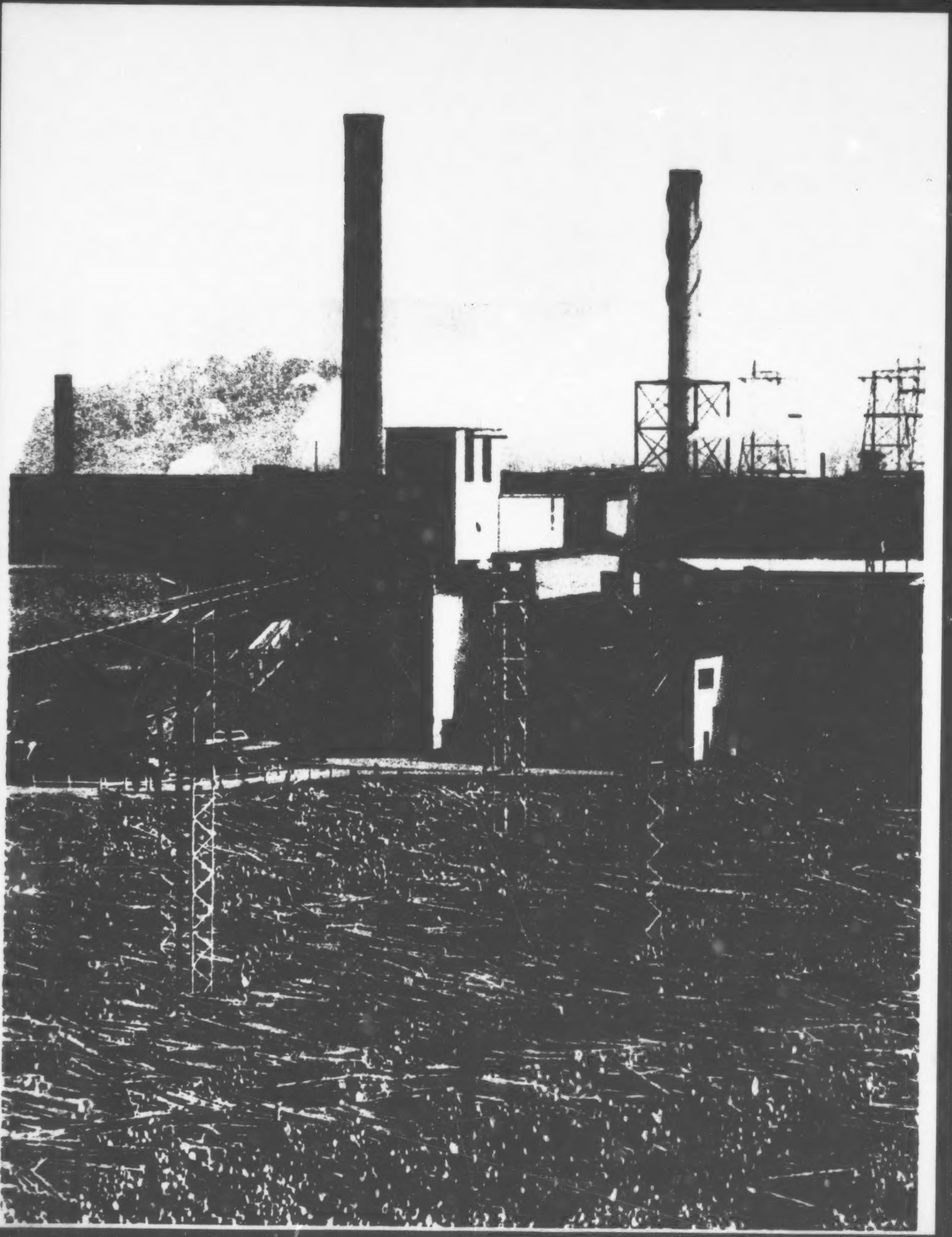
Plastics Processing Industry
Energy Use

Type	Units	Terajoules	Percentage Distribution 1988	1987	1979
Electricity	377,152 MWh	1,357.8	50.8	49.5	40.0
Natural Gas	31,756,357 m^3	1,181.3	44.2	47.2	55.5
Liquid Petroleum Products:					
Distillate Oil	1,408,683 L	55.1	2.1	0.5	1.0
Residual Oil	1,165,200 L	47.2	1.7	2.1	3.0
Diesel & Gasoline	373,588 L	14.8	0.6	0.3	0.2
Other Fuels:					
Propane	446,380 L	11.9	0.6	0.4	0.3
Total		2,668.1			

Performance Statistics

Current year total energy inputs:	2,668.1 Terajoules
Base year (1985) equivalent inputs:	3,083.6 Terajoules

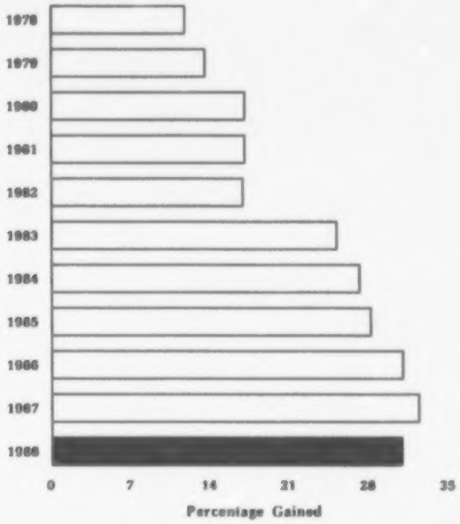
Efficiency Improvement 1980 to 1985 = 31.48%
1986 = 4.35%
1987 = 3.63%
1988 = 5.49%
Total 44.95%



Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 123 mills accounting for about 98% of the total pulp, paper and paperboard produced in Canada in 1988. Six of the mills included in the report are not members of the Association. A list of participating companies appears at the end of this annual report.

Progress Toward Improved Energy Use Efficiency

Overall energy use efficiency of the Canadian pulp and paper industry continued to improve in 1988. However, purchased energy per ton of product increased slightly during the year, with the result that the reduction in purchased energy since 1972 now represents 31.3% versus the industry's objective of 33% reduction for the year 1990. This objective had been attained in 1987.

The major energy source continues to be purchased electricity which accounts for 43.9% of the total purchased energy. Heavy fuel oil has shrunk to 24.5% of the total, which is 34% of the amount used on an equivalent production basis in 1972.

On a unit energy basis, there was a reduction in the use of purchased electricity in electric boilers, but this was more than offset by increases in the use of heavy fuel oil and natural gas. Purchased electricity for motive power continued to increase in 1988, reflecting the trend of gradual replacement of sulphite pulping with mechanical pulping processes, particularly in newsmills.

Self-generated energy usage per ton of product declined during 1988, with the result that total energy usage per ton of product declined.

The reduction in heavy fuel oil use is equivalent to 3.78 billion litres, and in total purchased energy use is equivalent to 3.57 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Production for 1988 was a record for the industry. Shipments of pulp and paper by the Canadian industry rose by 2% over 1987, with printing, writing and sanitary grades showing the largest increase. The industry as a whole operated at 98% of capacity for the year.

Replacement of fossil fuels with wood wastes generated by the industry and neighbouring wood products operations levelled off during the past year. These wood wastes now account for 67% of the total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 55% of the total energy used, up from 42% in 1972.

Technological Developments

Many of the projects in PAPRICAN's research program have integral energy conservation objectives and result in the generation of technological concepts that yield potential reductions in energy consumption and

Photo – Pulp and Paper Operation
Abitibi-Price Inc.

improved overall energy management.

As a continuation of the efforts by PAPRICAN to help solve sludge disposal problems, tests are being carried out in a project partly funded by Energy, Mines and Resources Canada to assess the technical and economic viability of drying pulp and paper mill sludges directly with oil as the heat transfer medium, and vapour recompression applied to the evaporated water as the source of heat. The objective is to obtain a very low moisture content fuel with high heating value, that can be used in combination fuel fired boilers and even lime kilns, thus alleviating disposal problems as well as reducing the mill's purchased energy requirements.

An experimental apparatus was built to carry out batch drying tests of sludges suspended in oils at temperatures up to 150°C and filtration of the sludges from the oil at close to drying temperature. The tests were carried out with newsprint and kraft mill sludges using bunker C and tall oil as drying media. The range of drying temperatures tested was 100°C to 130°C.

Product moisture contents of less than 5% (wet, oil-free basis) were obtained at relatively high drying rates, with temperatures of around 110°C and residence time of about four minutes.

It was found that due to its low flash point (approx. 66°C) bunker C oil is not a suitable drying medium. At drying temperatures above 100°C a substantial amount of volatile compounds are lost with the condensate. This will result in:

(i) a sizeable amount of fuel loss
(ii) potential fire or explosion hazard if mixed with air
(iii) a significant implication on the BOD and toxicity load of the mill effluent.

Tall oil appears to be a more favourable drying oil since its flash point is above 200°C and all of the above adverse effects are minimized.

Table I

Pulp and Paper Industry
Energy Efficiency Improvement

Current year (1988) total energy inputs	334.95×10^{15} Joules
Base year (1972) equivalent energy inputs	487.68×10^{15} Joules

$$\text{Improvement} = \frac{\text{Base year equivalent} - \text{current year inputs}}{\text{Base year equivalent}} \times 100$$

$$= \frac{487.68 - 334.95}{487.68} \times 100 = 31.3\%$$

Adjustments — None

Survey Data

Number of companies in 1988 report	62
Number of plants in 1988 report	123
Current year consumption	334.95×10^{15} Joules
Current year production	26,341,937 tonnes
Base year consumption	354.29×10^{15} Joules
Base year production	19,136,895 tonnes
Base year volume equivalent consumption	487.68×10^{15} Joules
1990 goal (relative to 1972 base year)	33%

Table II

Pulp and Paper Industry
Purchased Energy Consumption

Energy Source	1972* Joules X 10^{15}	Percentage of Total	1987** Joules X 10^{15}	Percentage of Total	1988** Joules X 10^{15}	Percentage of Total
Coal	16.98	3.5	4.77	1.5	4.86	1.5
Petroleum Products:						
Residual Oil	240.01	49.2	69.01	21.6	81.92	24.4
Distillates	8.87	1.8	4.72	1.5	4.76	1.4
Natural Gas	98.22	20.2	86.25	26.7	94.02	28.1
LPG	0.98	0.2	0.78	0.3	0.89	0.3
Other	5.05	1.0	1.65	0.5	1.41	0.4
Electricity (purchased)	117.57	24.1	152.79***	47.9	147.09 ****	43.9
Totals	487.68	100.0	318.98	100.0	334.95	100.0

*Reported on 1972 unit use adjusted to 1988 production

**Actual Use

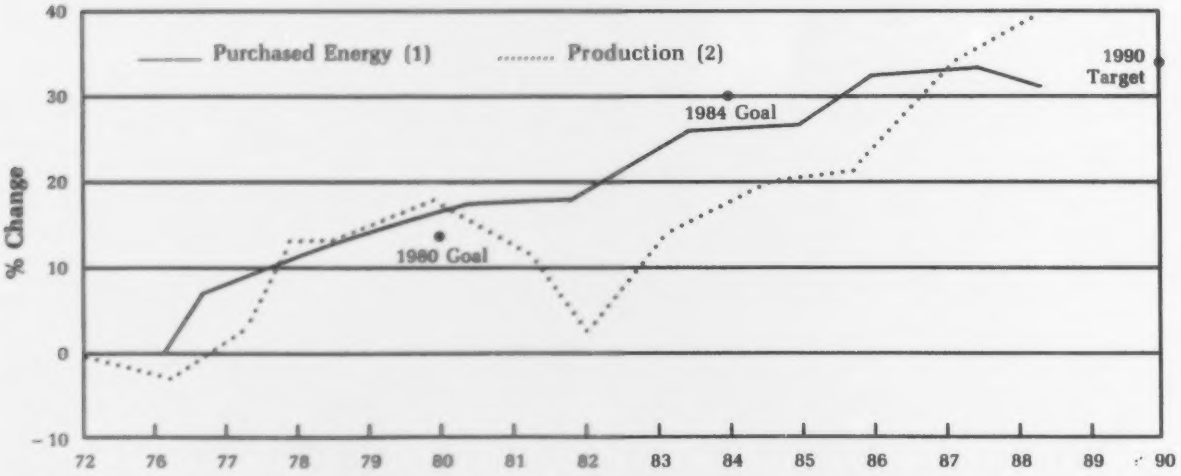
***32.92 X 10^{15} Joules (10.3%) used in electric boilers

****21.56 X 10^{15} Joules (6.4%) used in electric boilers

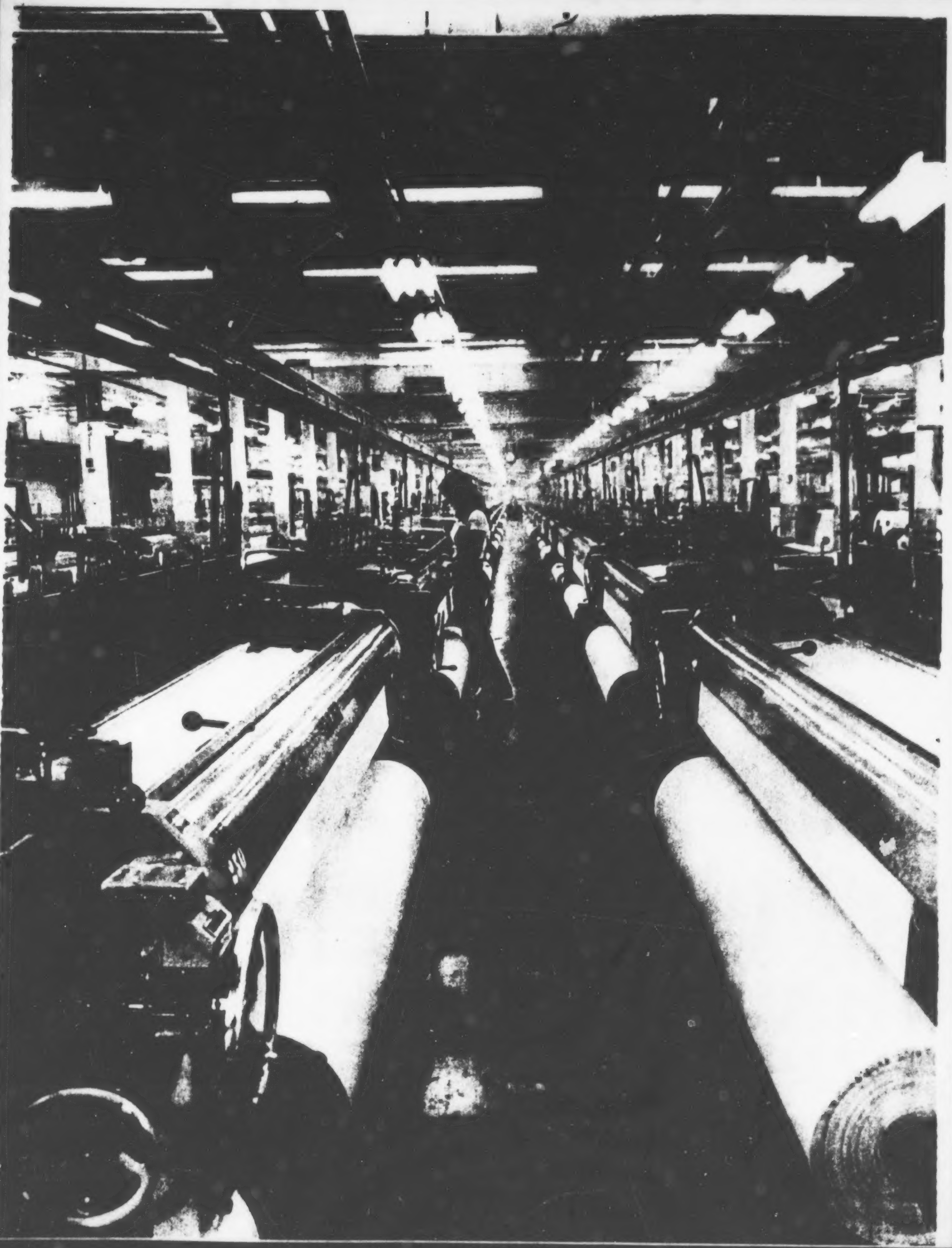
Figure I

Pulp and Paper Industry
Purchased Energy Use
Efficiency Improvement vs Production

Percentage Change – 1972 through 1988



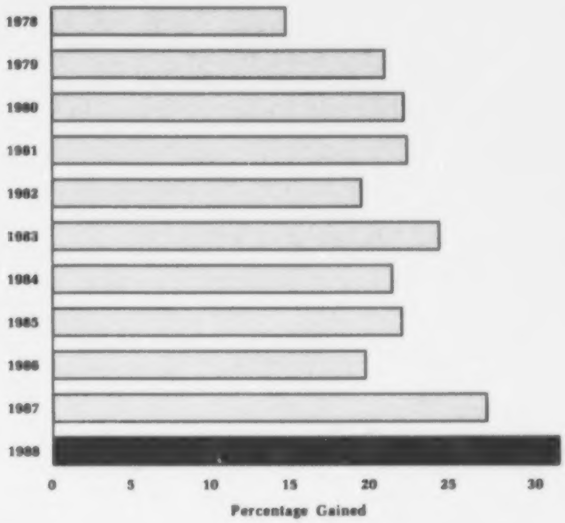
1. % Decrease in Purchased Energy/Tonne
2. % increase in Production vs Base Year



Textile Industry

Energy Management Task Force

Luis G. Monton
Chairman



Efficient energy management combined with a good production year resulted in an energy consumption improvement of 5.0% per kilo of product in the primary textile industry during 1988. The primary textile industry shipped goods valued at $6.7 billion during 1988 and employed roughly 60,200 Canadians.

When most people think of the primary textile industry they think of the clothes they wear and the sheets they sleep on. While the primary textile industry does provide the cloth used to dress Canadians and furnish their homes, it also does much, much more. The primary textile industry ships over half of its annual production to more than 150 manufacturing industries. Geotextiles are used to help stabilize airport runways and major highways. In new construction textile fabrics are used as air barriers to improve energy efficiency. Fire hoses, safety harnesses, upholstery, vinyl coated products, seatbelts and some wallpapers as well as cords, cordage and twine, are more examples of primary textile products.

Primary textile products include both natural and synthetic fibres. Some of the processes involved in their production include spinning and weaving, bleaching, printing and drying. These are processes which depend on the consumption of energy. The Textile Industry Energy Management Task Force of the Canadian Textiles Institute works hand-in-hand with the industry and Energy, Mines & Resources to help make the use of that energy more efficient.

Over 60 of Canada's most important primary textile producers take part in the task force and their production accounts for more than 90% of Canada's primary textile output. The task force includes those companies that sell their products directly to other manufacturing industries as well as those which sell finished products such as drapes, carpets, upholstered goods, knitwear and blankets for consumption at home and abroad.

1988 Performance

Energy efficiency in the primary textile industry improved 5.0% during 1988. When this figure is added to the improvements posted between 1974 and 1987, it brings the total percentage gained in energy efficiency to 31.6%, 2.6% above the target set by the Textile Task Force for 1990. While this is an impressive gain it should be remembered that to a large degree it was the result of a buoyant economy driving the mills to near capacity utilization. The value of goods shipped by the primary textile industry rose to $6.7 billion in 1988 over $6.1 billion in 1987.

While the industry is doing well now, its future is not assured. Faced with the economic uncertainty created by the prospect of increased imports, and influenced by relatively cheap oil, producers feel that introducing the new generation of energy efficient technologies will have to be justified by more certain economic returns.

These factors have created a situation where energy project paybacks must be short and most energy gains are made through vigilant, energy efficient housekeeping and maintenance.

Task Force Activities

During 1988 the task force made a number of significant changes in the way it operates and laid the foundation for further changes in 1989. These changes were designed to bring home the necessity for increased energy efficiency awareness and improve the dissemination of practical energy efficiency techniques.

Photo – Weave Room
Dominion Textiles Inc.

In 1988 the Energy Conservation Task Force changed its name to the Energy Management Task Force. This was done to change perception more than fact. The problem presented by the term "energy conservation" is that it carries a negative connotation. To some, it implies a forced lessening of the available energy supply. To others, it flies in the face of the fact that a certain amount of energy will always be needed to produce a certain amount of product – no matter what the ratio.

To combat these negative concepts, the textile group has changed its name and the name of its committees and publications from "Energy Conservation" to "Energy Management". This has been done to better reflect the sound logic that wise energy management translates into lower production costs and higher profit margins. As well, the task force decided that in 1989, it would hold its meetings in scientific and industrial settings where new energy efficient machinery could be studied first hand.

In 1988 the Textile Energy Management Task Force issued a series of three messages to CEO's in the industry. These short memoranda were designed to help raise energy efficiency consciousness by showing the direct influence wise energy management has on the bottom line.

The Textile Energy Management Task Force is divided into two committees: the Energy Management Committee and the Technical Liaison Subcommittee. The Energy Management Committee is responsible for raising awareness of the need for greater efficiency in the primary textile industry as a whole. The Technical Liaison Subcommittee is responsible for showing plant managers and the people on the floor how to do it. The committees are made up of representatives of the textile industry, public and private utilities, and energy consultants.

Jointly they issue two sets of publications which over the years have served as models for other CIPEC task forces. The first, "Energy Management Notes", is designed as a general interest energy efficiency newsletter. It provides a synopsis of energy efficiency news and details the effects of new regulations and energy programs on the textile industry. As well, the publication lists upcoming events and seminars which will be of interest to energy managers.

The second, "Energy Management Techniques" is a technical publication which uses case histories from the textile industry to show how important energy gains can be made. Both publications emphasize that energy efficiency is a valuable tool for improving profit margins.

In 1988 the Technical Liaison Subcommittee organized two seminars on steam, one in English and one in French. The excellent manuals produced by Energy, Mines & Resources were used to form the basis of the seminars. Different aspects of how to make steam and condensate handling systems more efficient were presented by a cross-section of consultants and personnel from the textile industry and public and private utilities. As always, case histories provided by the participants were used as the basis for a round-robin problem solving session held at the end of each seminar.

While the nature of the seminars scheduled for 1989 is not confirmed as yet, the Technical Liaison Subcommittee is convinced that they will be as successful in providing information on cutting energy costs as those in the past have been.

Case History

One primary textile operation which consumes large amounts of energy is the drying of fabric. In the past this has largely been done by using steam heat exchangers as a drying mechanism. Recent studies have shown, however, that direct-fired natural gas heating of tenter frames can reduce energy consumption by 35%, increase productivity by 15% and provide better quality finished goods.

Against these advantages lies the fear that fabric colour degradation occurs with direct-fired tenter frame heating, although studies conducted in 1975 showed that, if the air circulating in the tenter frame is kept below 450°C, this will not happen.

The main advantage to the direct-fired natural gas system is that at lower calorific values, energy efficiency is 100%. This is against the 65% estimated best efficiency rating for boiler fed heating systems. Boiler systems lose efficiency through boiler combustion losses, stack losses, radiation losses and distribution line losses.

In a feasibility study conducted on a 1.4 million BTU dryer, it was found that it would cost $85,000 to convert to natural gas direct-fired heating. This price included bringing in the new gas lines. In return, the finishing plant would save $15,000 a year in energy costs and gain 15% more production.

Another benefit of direct-fired gas heating is that it can save large sums in manpower costs. When these are combined with energy savings they provide an extremely short payback period. Consider a finishing plant boiler that supplies 85,000 lbs. of pressure per hour. By installing direct-fired dryers, the required boiler pressure can be reduced to 40,000 lbs. or less. This means that the boilers will no longer have to be continuously supervised by stationary engineers. This can result in a possible saving of $100,000 or more per year in manpower costs.

Energy Use Patterns

Energy use patterns in the primary textile industry barely changed during 1988. While the amount of energy per kilo of product dropped by 9.5%, the proportions of oil, natural gas and electricity remained stable. This indicates that producers do not believe that investments in new technologies are economically justified at this time and are concentrating their energy management activities on projects with short payback periods.

Future Outlook and Concerns

The primary textile industry has now met and surpassed its 1990 target for energy efficiency improvement. Because much of the gain was the result of the industry working at near full capacity it is still to be seen how much of this gain can be retained in coming years.

Due to uncertain conditions in the industry, the Textile Energy Management Task Force will continue to stress that significant energy gains can be made through routine maintenance operations and housekeeping.

We will also continue to emphasize the financial gains that can be made through improved energy efficiency and illustrate those gains through the publication of practical case histories and the organization of relevant seminars.

CIPEC has been an effective program since its beginning. The Energy Management Committee of the Canadian Textiles Institute hopes that all levels of government will continue their support of CIPEC, and in this way match the time and labour spent by industry to make sure that this successful program continues.

Table I

Textile Industry
Energy Efficiency Improvement

Total (1988)	8,242,073 gigajoules
New base year (1985) equivalent energy inputs	9,107,491 gigajoules

Net Improvement = 9.5%

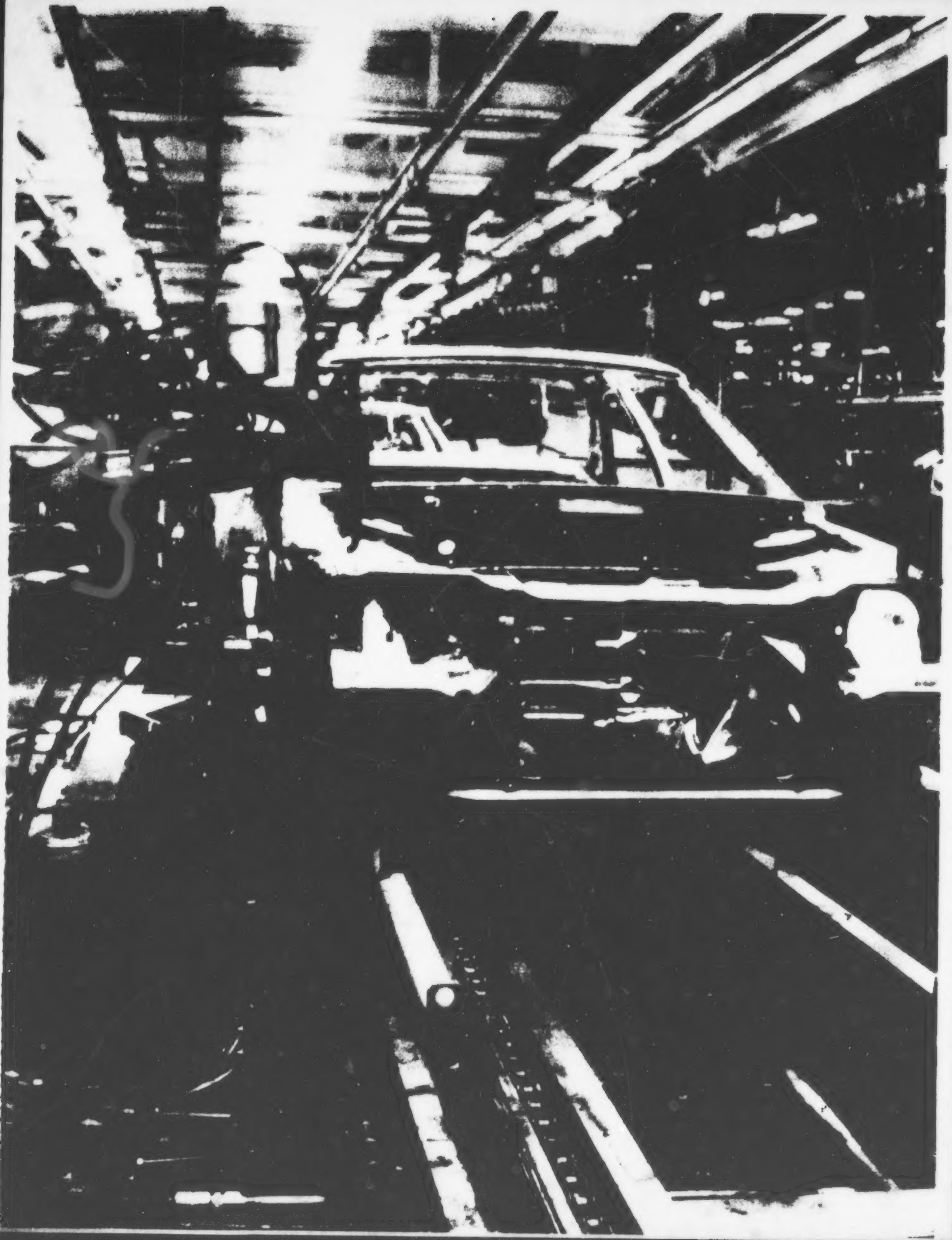
Adjustments — None

Efficiency gain 1974 - 1985	22.1
1986	–2.3
1987	6.8
1988	5.0
Total gain 1974 - 1988	31.6%

Table II

Textile Industry
Energy Use

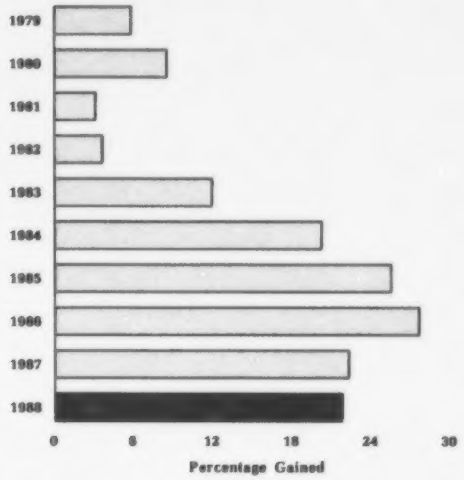
			Percentage of Total Consumption		
Type	Units	Gigajoules	1988	1987	1986
Natural Gas	121,753,000 m³	4,529,212	55.0	55.6	52.5
Electricity	803,731 MWh	2,893,431	35.1	35.8	36.7
Liquid Petroleum Products:					
Distillate Oil	468 kL	18,252	0.2	0.1	0.1
Residual Oil	17,743 kL	750,528	9.0	7.6	9.8
Diesel & Gasoline	348 kL	13,241	0.2	0.2	0.2
Other Fuels:					
Propane & LPG	1,200 m³	31,875	0.4	0.4	0.5
Other Gaseous Fuels	110 m³	5,533	0.1	0.3	0.2
Total (1988)		8,242,073			



Transportation Industry (Manufacturing)

Energy Management Task Force

Ian Hatcher
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Energy Management Task Force has a membership of 580 companies from the following six participating trade associations:

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers' Association (APMA)
- Canadian Maritime Industries Association (CMIA)
- Canadian Truck and Trailer Manufacturers' Association (CTTMA)
- Motor Vehicle Manufacturers' Association (MVMA)

There are 96 companies reporting their energy usage for 1988, an increase of 66% over the 58 companies which reported in 1987. Energy use reported by these companies represents some 80% of the total energy used by the transportation (manufacturing) sector. While 47 new companies reported this year, the energy efficiency changes continue to be dominated by a few very large energy consuming manufacturers concentrated in the MVMA sub-sector. All of these large energy-using companies practice organized energy management and conservation.

Task Force Activities

It is the belief of the task force that company participation in the CIPEC energy reporting process will result in an increased awareness of energy consumption patterns at the company operating level, and that this awareness will result in increased efforts to control energy costs and improve energy efficiency. Towards this end, over the past year the task force has concentrated its efforts on developing a simplified data collection form. This simplified form, in conjunction with the use of an experienced representative to encourage and assist companies in preparing their data collection reports, is credited with the significant increase in 1988 reporting companies.

The Idea Exchange newsletter published by the task force and distributed to over 600 energy managers continues to be a popular communication tool which keeps sector companies abreast of energy-related matters.

Energy Use Patterns

Natural gas continues to increase its share of total energy consumed by our sector, increasing to 57.9% in 1988, up from 56.7% the previous year, and from the 1980 share of 49.1% shown in the Energy Use Table. This increase in share appears to be at the expense of electricity, which dropped to 31.5% in 1988, down from 32.8% in 1987. This apparent shift in energy usage may be a result of the reductions in the price of natural gas over the past two years.

Photo – Transportation (Mfg.)
Ford Motor Company of Canada Limited

Performance

As shown in the Sector Performance Table, three task force sub-sectors continue to report gains in energy efficiency, showing improvements of between 1.9% and 4.6%; two sub-sectors show almost no change in their energy efficiency; while one sub-sector shows a decline of – 6.7%.

Overall, compared to the base year of 1985, adjusted for changes in levels of output, the 1988 task force report shows a decline of – 3.5% in energy efficiency. This figure is similar to the 1987 decline of – 3.3%.

The decline in energy efficiency for 1988 is primarily attributable to a very few companies in the dominant Motor Vehicle Manufacturers' Association sub-sector, where lower production volumes due to model changes and production line retooling have had a significant negative impact on energy efficiency.

Companies in several sectors have reported that gains in energy efficiency resulting from improvements to processes and energy conservation measures have, in some instances, been offset by increased energy usage of heating and ventilating systems needed to meet increasingly stringent air quality requirements, driven by the current emphasis on occupational health and safety. It is noteworthy that many of these new heating and ventilating system installations had energy efficiency specified at the time of procurement.

Additionally, a number of companies have reported a continuing trend towards more automation and robotics in their manufacturing processes, and to more computers in their office environments. These long-term changes will result in more energy-intensive operations.

Subsector Performance

Sector Performance showed continued improvement in energy efficiency of the Aerospace Industries Association of Canada with a gain of 2.8%.

The Automotive Parts Manufacturers' Association of Canada achieved an excellent gain of 4.6%.

A gain of 1.9% is reported by the Canadian Maritime Industries Association.

These three sub-sectors show a combined energy efficiency improvement of 3.9%.

The Allied Boating Association of Canada and the Canadian Truck and Trailer Manufacturers' Association show almost no change in their energy efficiency, with changes of 0% and – 0.2% respectively.

The decline in energy efficiency of – 6.7% for the Motor Vehicle Manufacturers' Association does not reflect the energy conservation efforts of its member companies. The results reflect changes in production volume of some sub-sector companies caused by model changes and retooling activities, during which time the plants consume significant amounts of energy with almost zero output. In fact, several MVMA sub-sector companies show a definite improvement in energy efficiency. All major energy using companies in this sub-sector report continued efforts to improve their competitive position through better energy management programs.

Future Outlook and Concerns

The task force anticipates an improvement in the capacity utilization of the MVMA sub-sector during 1989 and 1990. This will result in a significant improvement in our overall energy efficiency of 10% in 1990 compared to the 1985 base year.

The participating companies in the transportation (manufacturing) sector continue to promote energy conservation as a means of improving their competitive position. The 66% increase in participation in the 1988 survey over 1987 participation is a reflection of increased interest in energy management and reflects better data collection by the task force. This increased participation in the CIPEC energy reporting process and the awareness of energy efficiency and its related costs brought about by participation will, in the opinion of this task force, result in efforts to improve energy efficiency by the participating companies.

The task force believes that energy management is an issue for the 1990's – in terms of the competitive position of our sector companies, and also because of the concern for the environment. CIPEC is the vitally needed communication tool providing a link between the vast industrial network and government. With effective energy management and communication industry will be in a better competitive position and will be better able to contribute to a cleaner environment.

Table I

Transportation Industry (Mfg.)
Energy Efficiency Improvement

Current year (1988) total energy inputs	46,601,739 gigajoules
New base year (1985) equivalent energy inputs	45,020,229 gigajoules

Net Improvement = –3.5%

Efficiency gain 1978 - 1985	25.6
1986	2.1
1987	–5.4
1988	–0.2
Total gain 1974 - 1988	22.1%

Table II

Transportation Industry
Energy Use

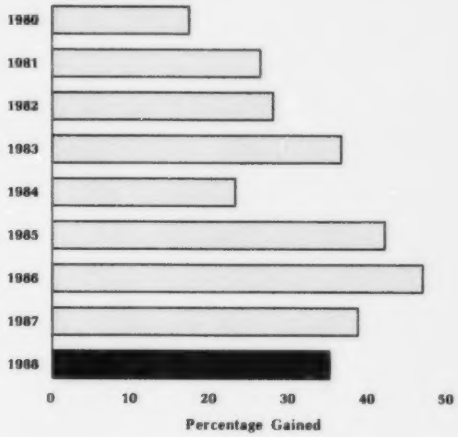
Type	Units	Gigajoules	Percentage of Total Consumption 1988	1985	1980
Natural Gas	725,550,321 m^3	26,990,472	57.9	54.7	49.1
Electricity	4,076,839 MWh	14,676,620	31.5	30.1	23.6
Liquid Petroleum Products:					
Distillate Oil	14,730 kL	574,502	1.2	1.2	0.7
Residual Oil	18,953 kL	768,045	1.7	2.1	14.7
Diesel & Gasoline	1,925 kL	74,034	0.1	0.3	0.5
Coal	30,105 tonnes	818,555	1.8	3.6	5.9
Coke	92,253 tonnes	2,491,436	5.4	7.4	5.1
Other Fuels:					
Propane	7,616 kL	202,578	0.4	0.6	0.4
LPG	203kL	5,498	0.1	—	—
Total (1988)		46,601,739			

40-74

Wood Products Industry (Western)

Energy Conservation Task Force

R.C. Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 56 operating sawmills owned by 20 companies, which accounted for 43% of the lumber produced in B.C. in 1988. The coverage in 1988 represents a substantial increase over the 1987 survey which accounted for 36% of B.C. production. In addition to B.C. mills, the report includes several Alberta sawmills for the first time. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as the above-noted mills in Alberta.

Goals and Progress to Date

The industry's goal for 1990 is a 7% overall increase in energy efficiency from the 1985 base year performance. Although the industry's overall average efficiency in 1988 vs. 1985 (– 3.7%) represents an improvement over the performance achieved in 1987 (– 5.1%), it is still below the 1985 base year level. The results do, however, show an improvement of 41.1% over the 1978 base year.

Average electrical energy consumption for the production of green lumber lost ground in 1988 and was 8.5% more than in 1985. Compared with 1978, however, the 1988 performance represented a 12% improvement.

Although average natural gas consumption in the kiln drying of lumber in 1988 improved substantially compared to the year before, it was barely even with the 1985 base year performance. Compared with the 1978 base year, however, there was an improvement of over 54%.

The size of our reporting sample has increased substantially this year. The total for green lumber produced in the 1988 sample was 20% greater than the 1987 sample. The reporting sample for kiln-dried lumber in 1988 was over 40% larger than the previous year's sample, an even more dramatic increase.

There is no obvious, single reason why the electrical energy use in mills converting logs to green lumber rose in 1988. Part of the

Photo – MacMillan Bloedel Ltd.

explanation for this decline in energy efficiency, however, may lie in the substantial increase in stumpage charges faced by the industry in 1988 and a focus of attention on achieving cost reductions in areas felt to be more significant than electrical energy costs. Total energy costs, as a proportion of all costs ranged from about 1.5% in B.C. coastal mills up to about 3.5% in some B.C. interior mills. Electrical energy costs alone would likely be closer to the 1.5% of total costs experienced in coastal mills where most lumber is not kiln-dried.

In the interior of the province it is customary to kiln-dry lumber using either natural gas or wood waste energy systems. When natural gas prices were rising, through the late 1970's and early 1980's many mills switched from natural gas to wood waste energy systems. Recently, mainly as a result of deregulation, natural gas prices have been falling, making that fuel more attractive. In 1988, mills which could take advantage of deregulation saw natural gas prices decline as much as 30%. Thus, another explanation for declining energy performance regarding natural gas had to do with falling prices which lessened the incentive to switch to wood waste and may have caused some mills to increase natural gas use rather than make use of wood waste.

The phenomenon of price declines due to deregulation will not alter the fact that over the longer term, natural gas prices can be expected to rise, eventually restoring the incentive for wood waste conversions.

Task Force Activities

COFI continues to provide a secretariat/coordinating role regarding the B.C. wood products industry's energy initiatives. Typically, these activities focus on regulatory matters or other aspects concerning the terms and conditions of energy supply.

Activities in 1988 centred on the proposed natural gas pipeline to Vancouver Island and the possibility of replacing heavy fuel oil, local and imported, with natural gas. Energy conservation related activities were largely limited to collecting, analysing and reporting the energy performance data contained in this report.

Future Outlook

The wood products sector is experiencing a reduction in demand as a result of reduced housing starts in North America. Lumber consumption is expected to slow further, in line with anticipated slower economic growth in both Canada and the United States.

Concerns regarding increased stumpage must be addressed in the context of a cyclical downturn in the industry. Unfortunately, producer revenues have also been cut significantly due to the rising value of the Canadian dollar vis-a-vis the U.S. dollar.

These issues lead to considerable uncertainty regarding the short-term outlook for the industry. Over the longer-term, western sawmills will gradually attempt to reduce their output of construction lumber, a commodity product, and to replace that production with higher value-added products.

Wood Products Industry (Western)
Energy Efficiency Improvement

Green Lumber	**1988**	**1985**	**1978**
Total sample production (million board feet — MMFBM)	6816.8	5052.0	4202.2
Total energy consumption (10^{12} J)	3281.1	2241.5	2297.7
Average electrical energy consumption (10^{9} J per MFBM)	0.481	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3281.1	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3024.5		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3727.3		

Improvement (1985 base year) = –8.5%

Improvement (1978 base year) = 12.0%

Kiln Dried Lumber	**1988**	**1985**	**1978**
Total sample production (MMFBM)	4817.6	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	3703.7	2433.0	1708.8
Average energy consumption (10^{9} J per MFBM)	0.769	0.770	1.687
Current year total energy inputs (10^{12} J)	3703.7	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3710.0		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	8123.7		

Improvement (1985 base year) = 0.2%

Improvement (1978 base year) = 54.4%

Combined Energy Performance	**1988 Actual**	**1985 Equiv.**	**1978 Equiv.**
Total electrical energy consumption (Green Lumber 10^{12} J)	3281.1	3024.5	3727.3
Total natural gas consumption (Kiln Dried 10^{12} J)	3703.7	3710.0	8126.7
Total sector energy consumption 10^{12} J	6984.8	6734.5	11854.0

Improvement (1985 base year) = –3.7%

Improvement (1978 base year) = 41.1%

Reporting Companies

Chemical

Alberta Gas Chemicals Ltd.
Alby Chlorates Inc.
Ashland Chemicals Inc.
Atkemix Inc.
BASF Canada Inc.
B.C. Chemicals Ltd.
B.F. Goodrich Canada Inc.
Borden Company Limited
Carlew Chemicals Limited
Celanese Canada Inc.
CIL Inc.
Commercial Alcohols Limited
Cyanamid Canada Inc.
Dominion Colour Company
Domtar Chemicals Group
Dow Chemical Canada Inc.
DuPont Canada Inc.
Emery Chemicals Ltd.
Esso Chemicals Canada
G.E. Plastics Canada Inc.
General Chemical Canada Inc.
Hart Chemical Limited
Henkel Canada Inc.
Himont Canada Inc.
H.L. Blachford Ltd.
Hoechst Canada Inc.
Huls Canada Inc.
Lubrizol Canada Ltd.
Monsanto Canada Inc.
Nacan Products Ltd.
National Silicates Limited
Nitrochem Inc.
NL Chem Canada Inc.
Novacor Chemicals Ltd.
Ocelot Industries Ltd.
Pétromont Inc.
Pigment & Chemical Inc.
Polysar Limited
Procter & Gamble Inc.
QuéNord Inc.
Reed Inc.
Rohm and Haas Canada Inc.
Shell Canada Chemical Company
Sulco Chemicals Limited
Surpass Chemicals Ltd.
Tioxide Canada Inc.
Union Carbide Canada Limited
Uniroyal Chemical

Electrical and Electronic

3M Canada Inc.
Allanson, a Division of Jannock Ltd.
Alcan Wire and Cable Ltd.
Allen-Bradley Canada Ltd.
Allied-Signal Aerospace Company, Garrett Canada
Andrews Antenna Co. Ltd.
Arcair Canada Limited
Ascolectric Ltd.
Black & Decker Canada Inc.
B.B. Howden Inc.
Burndy Inc.
CAE Electronics Ltd.
Camco Ltd.
Canada Wire and Cable Ltd.
Chromalox Inc.
Commander Electrical Materials Inc.
Commander Electrical Equipment Inc.
Crouse-Hinds Electrical Construction Materials Ltd.
Eaton Yale Ltd.
Edwards, a unit of General Signal Ltd.
Erico Canada Inc.
Federal Pioneer Ltd.
Furnas Electric Company
General Electric Canada Inc.
General Wire & Cable Ltd.
Gennum Corporation
Gould Shawmut Company Ltd.
GTE Sylvania Ltd.
Hamilton Porcelains Limited
Holophane Inc.
Honeywell Limited
Hoover Canada Inc.
Hubbell Canada Inc.
Hydel Engineering Limited
Inglis Limited
Iona Appliances Inc.
ITT Cannon Canada Ltd.
Klockner Moeller Ltée
L-Tek Canada Inc.
Lincoln Electric Co. of Canada Ltd.
Marine Industrie Limitée
Motorola Information Systems
NEI Ferranti Packard Electronics
Pursley Inc.
Pyrotenac of Canada Limited
Sanyo Canada Inc.
Schlumberger Industries, Sangamo Electricity Division
Smith & Stone (1982) Inc.
Spar Aerospace Limited
Square D Canada Ltd.
Temco Electric Products Co. Inc.
Texas Instruments Canada Limited
Thomas & Betts Ltd.
Thomson Consumer Electronics Ltd.
Trench Electric Ltd.
WCI Manufacturing Limited
Westcan Electrical Mfg. Inc.
Westinghouse Canada Inc.

Ferrous Metals

The Algoma Steel Corporation
Dofasco Inc.
Sidbec-Dosco Inc.
Stelco Inc.
Sydney Steel Corporation (Sysco)

Food and Beverage

Bakeries

Ben's Limited
Corporate Foods Limited
Eastern Bakeries Limited
McGavin Foods Limited

Biscuit Manufacturers

Christie Brown & Company Ltd.
Colonial Cookies Ltd.
Aliments Culinar Inc.
Interbake Foods Limited
Manning Biscuits Ltd.
Windsor Wafers Inc.

Breweries

Carling O'Keefe Breweries of Canada Ltd.
Labatt Breweries of Canada Limited
Molson Breweries of Canada Limited
Moosehead Breweries Limited
Northern Breweries Ltd.
Pacific Western Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
Donini Chocolate Ltd.
Ganong Brothers Ltd.
Hershey Canada (Montréal) Inc.
Kerr Bros. Limited
Leaf Confections Ltd.
O-Pee-Chee Company Ltd.
Rowntree Mackintosh Canada Ltd.
Trebor Canada Inc.
William Neilson Ltd.
Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
Canadian Mist Distillers Limited
FBM Distillery Co. Limited
Gilbey Canada Inc.
Hiram Walker & Sons Limited
Gooderham & Worts Limited
Joseph E. Seagram & Sons, Limited
Liqueurs Saguenay Ltée
Palliser Distillers Limited

Food Processors

Campbell Soup Company Ltd.
E.D.Smith & Sons Limited
Hunt-Wesson Canada Ltd.
H.J.Heinz Company of Canada Ltd.
Morrison Lamothe Inc.
Produce Processors Limited
Royal City Foods Ltd.
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Sun-Rype Products Ltd.
Thomas Canning (Maidstone) Ltd.

Fisheries

British Columbia Packers Limited
Blue Water Seafoods Limited
National Sea Products Limited

Grocery Products Manufacturers

Agropur Cooperative Ltée
Campbell Soup Company Ltd.
Canadian Home Products Ltd.
Catelli Inc.
Culinar Inc.
General Foods Ltd.
Jacobs Suchard Canada Inc.
Kraft Ltd.
Lancia Bravo Foods Limited
Monarch Fine Foods Ltd.
Nabisco Brands Ltd.
Nabisco (Canned Goods) Ltd.
Nabisco Food Services
Royal City Foods Ltd.
Thomas J. Lipton Inc.

Meat Processors

Canada Packers Inc.
F. W. Fearman Company Ltd.
Intercontinental Packers Ltd.
J. M. Schneider Inc.
Piller Sausages & Delicatessen Ltd.
Quality Meat Packers Ltd.
Unox, Division of
  Thomas J. Lipton Inc.
Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

A.C.A. Co-operative
  Association Ltd.
Bexel, Division of Co-op.
  Fédérée de Québec
Canada Packers Inc.
Co-op Dorchester Ltée
Export Packers Company Ltd.
La Poulette Grise Inc.
Lashbrook Produce Limited
Lilydale Co-op Limited
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Leaf Mills Limited
Maple Lynn Foods Ltd.
Pembina Poultry Packers Ltd.
P & H Foods Ltd.

Soft Drink Manufacturers

Amalgamated Beverages Ltd.
Beverage Services Ltd.
Binet et Turgeon Ltée
Breuvages Drummond Ltée
Breuvages Radnor Ltée
Canada Dry Bottling Co. Ltd.
Goodwill Bottling Ltd. (Victoria)
Goodwill Bottling Ltd. (Nanaimo)
Goodwill Bottling Ltd.
  (Campbell River)
Goodwill Bottling Ltd.
  (Prince George)
Goodwill Bottling Ltd.
  (Prince Rupert)
Goodwill Bottling Ltd. (Terrace)
Goodwill Bottling Ltd. (Smithers)
Gray Beverage Inc.
Ideal Sport Inc.
Les Breuvages Déraspé Ltée
Maedel's Beverages Ltd.
Maritime Beverages Ltd.
Pathfinder Beverages Ltd.
Pepsi Cola Canada Ltd.
Philippe Simard & Fils Ltée
Provincial Beverages Ltd.
Roux & Bergeron Ltée
S. Désormeaux Inc.
Seven-Up Valleyfield Ltée
Swift Current Bottlers Ltd.
T.C.C. Bottling (Calgary) Ltd.
T.C.C. Bottling (Cornwall) Ltd.
T.C.C. Bottling (Chicoutimi) Ltd.
T.C.C. Bottling (Chilliwack) Ltd.
T.C.C. Bottling (Coquitlam) Ltd.
T.C.C. Bottling (Drummondville)
T.C.C. Bottling (Edmonton) Ltd.
T.C.C. Bottling (Hamilton) Ltd.
T.C.C. Bottling (Granby) Ltd.
T.C.C. Bottling (Kamloops) Ltd.
T.C.C. Bottling (Kitchener) Ltd.
T.C.C. Bottling (Kingston) Ltd.
T.C.C. Bottling (London) Ltd.
T.C.C. Bottling (Quebec City) Ltd.
T.C.C. Bottling (North Bay) Ltd.
T.C.C. Bottling (Renfrew) Ltd.
T.C.C. Bottling (Richmond B.C.) Ltd.
T.C.C. Bottling (Sault St. Marie) Ltd.
T.C.C. Bottling (St-Paul) Ltd.
T.C.C. Bottling (St. John's) Ltd.
T.C.C. Bottling (Sherbrooke) Ltd.
T.C.C. Bottling (Sudbury) Ltd.
T.C.C. Bottling (Toronto) Ltd.
T.C.C. Bottling (Trois Rivières) Ltd.
T.C.C. Bottling (Uxbridge) Ltd.
T.C.C. Bottling (Vernon) Ltd.
T.C.C. Bottling (Weston) Ltd.

Starch Manufacturers

Casco Limited
Nacan Products Ltd.
Ogilvie Mills Ltd.
St. Lawrence Starch Co. Ltd.

Sugar Refineries

Atlantic Sugar Limited
British Columbia Sugar Refining
  Company Limited
Lantic Sugar Limited
St. Lawrence Sugar Division
  Natalik Inc.
Redpath Sugars Limited
Westcane Sugar Limited

Wineries

André's Wines Ltd.
Inniskillin Wines Inc.
Les Vins La Salle Inc.

General Manufacturing

Rubber Products

Gates Canada Limited
General Tire Ltd.
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal-Goodrich Canada Ltd.

Chemical, Pharmaceutical and Medical Products

Canadian Occidental Petroleum Limited
Diversey Wyandotte Inc.
E. F. Houghton Canada Inc.
Tambrands Canada Inc.
Valspar Chemicals Ltd.

Foundries, Forgings and Heavy Metal Processors

Aciers Slater Inc.
Ancast Industries Ltd.
Bibby-Ste-Croix Foundries Ltd.
Bowmanville Foundry Co. Ltd.
Brass Craft Canada Ltd.
Canada Forgings Inc.
Canadian Blower/Canada Pumps Ltd.
Canadian Bronze Company Limited
Canada Ingot Mould Inc.
Canron Inc.
Canvil Ltd.
Esco Ltd.
Fahramet, Indusmin, Div. of Falconbridge
Fondries Magotteaux Canada Ltée
Gray Forgings & Stampings Limited
Hawker Siddeley Canada Inc.
Huron Steel Products Limited
Lake Ontario Steel Company Limited
Manville Canada Inc.
Metals & Alloys Company Limited
Reynolds Aluminum Company Limited
The Canada Metal Company Limited
Western Foundry Co. Ltd.

Light Manufacturing

Atco Limited
Black and Decker Canada Inc.
Bombardier Inc.
Commercial Aluminum, a Div. of Indal Ltd.
Dorr-Oliver Canada Limited
Dominion Controls Co. Ltd.
Eimco Jarvis Clarke Company Limited
Fasco Products, Div. of Indal
Indal Technologies Inc.
Indalloy Ltd., Div. of Indal
Ivex Corporation
Kawneer Company of Canada Limited
Kodak Canada Inc.
Paddle Valley Products Limited
Snap-On Tools Ltd.
Teledyne Canada Metal Products Limited
Trane Canada Limited
Victory Soya Mills Ltd.

Industrial Minerals

Abrasives

Exolon - Esk Co. of Canada Ltd.
General Abrasives - Abrasives Industries (Canada) Inc.
Norton Advanced Ceramics of Canada Inc.
Washington Mills Electro Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar Division
Carey Canada Inc.
JM Asbestos Inc.
LAB Chrysotile (Bell) Inc.
LAB Chrysotile (Lac)
LAB Chrysotile (BC/KB/Normandie) Inc.

Cement

Ciment Québec Incorporated
Federal White Cement Limited
Genstar Cement Limited
Lafarge Canada Inc.
Lake Ontario Cement Limited
Miron Inc.
St. Lawrence Cement Inc.
St. Mary's Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée (Div of Jannock Ltée)
Canada Brick Company Limited
Canadian Vitrified Products Ltd.
Estevan Brick Ltd.
Hamilton Brick Ltd.
Medicine Hat Brick and Tile Ltd.
Medicine Hat Sewer Pipe Ltd.
NSP (Div of NSP Inc.)
Northwest Brick and Tile Ltd.
Redcliff Pressed Brick Ltd.
Red River Brick and Tile Ltd.
IXL Industries Ltd.

Concrete Products

Century Concrete Products Ltd.
Consolidated Concrete Products Ltd.
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Genstar Materials Limited
Richvale Block & Ready-Mix (Div of Lafarge Canada Inc.)
Redi-Mix Limited
York Block (Div. of Lafarge Canada Inc.)

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Domglas Inc.
Fiberglas Canada Inc.
Libbey St. Clair
PPG Canada Inc.

Lime

BeachviLime Ltd.
Guelph DoLime Ltd.
Havelock Lime Company of Canada Limited
Reiss Lime Company of Canada Limited
Summit Lime Works Limited

Miscellaneous Minerals

Indusmin Limited
3M Canada Inc.
Saskatchewan Minerals Ltd.
Steetley Talc Inc.

Refractories

A. P. Green Refractories (Canada) Limited
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories Company Limited
General Refractories Co. of Canada Ltd.

Machinery

ACCO Canadian Material Handling, a Division of Dominion Chain Inc.
Beloit Canada Ltée/Ltd.
Bingham International Inc.
Boart Canada Inc.
Canadian Blower/Canada Pumps Limited
Canron Inc., Mechanical Division
Continental Conveyor & Machine Works Ltd.
Continuous Mining Systems Limited
Crane Canada Inc., Valve & Industrial Division
R.J. Cyr Co. Inc.
Dominion Engineering Works, a Division of Canadian General Electric Company Limited
Ebco Industries Ltd.
Edson Packaging Machinery Limited
FAG Bearings Ltd.
Farris Industries Canada
FMC of Canada Limited, Material Handling Operation

Greey Lightnin, Unit of General Signal Limited
Heath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
H.G. Kalish Inc.
Kockums CanCar Inc.
Motivation Industrial Equipment Ltd.
MTD Products Ltd.
Pathex International Ltd.
Provincial Crane Inc.
RMS Machinery Division, Uniroyal Goodrich Canada Inc.
Smart Turner Limited
Union Pump (Canada) Ltd.
Ward Ironworks Limited
WEMCO Canada, Division of Baker International Canada Ltd.

Mining and Metallurgy

ACCO Canadian Material Handling, A Division of Babcock Ind. Canada Inc.
BEVCO Conveying Systems
Boart Canada Inc.
Canadian Blower/Canada Pumps Limited
Canron Inc.
Continuous Mining Systems Limited
Dominion Engineering Works Ltd.
Dresser Pump Division, Dresser Canada Inc.
Ecodyne Limited
FAG Bearings Ltd.
Gorman-Rupp of Canada Limited
Heath & Sherwood (1964) Limited
Hymac Ltd.
Industries USP Inc.
Ingersoll-Rand Canada Inc.
ITT Fluid Products Canada, Division of ITT Industries of Canada Ltd.
Jenkins Canada
H.G. Kalish Inc.
H.J. Langen & Sons Ltd.
M.A.N. Ashton Inc.
MacLean Engineering & Marketing Co. Ltd.
MTD Products Ltd.
Pullmaster Winch Corporation
RMS Machinery Division, Uniroyal Goodrich Canada Inc.
S.A. Armstrong Limited
Sanden Machine Limited
Smart Turner Limited
Sullivan Strong Scott, Division of Strong Equipment Corporation
Valmet-Enerdry Inc.
Ward Ironworks Limited
Webster Air Equipment, Division of Curtiss-Wright of Canada Inc.

Petroleum Refining

Consumers' Co-Operative Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Aclo Compounders Inc.
Acriform Engineering Ltd.
American Biltrite (Canada) Ltd.
Atlantic Packaging Products Ltd.
Beaver Plastics Limited
Bonar Plastics Ltd.
Burman-Castrol Canada Ltd.
Canada Cup Ltd.
Canadian General Tower Ltd.
Carlew Chemical Limited
Celfortec Inc.
Chantler and Chantler Inc.
Chemacryl Plastics Limited
Coastal Plastics Ltd.
Columbia Manufacturing Company Ltd.
Daymond, Div. of Redpath Industries Ltd.
Duron Plastics Ltd.
Emballage St-Jean Ltée
English Plastics Ltd.
F&H Plastics Ltd.
Ferro Industrial Products Ltd.
Fibracan, Div. of Innopac Inc.
Formica Canada Inc.
Gulf Plastics Ltd.
Hayden Manufacturing Co. Ltd.
Horizon Plastics Ltd.
IPL Ltd.
Jet Moulding Compounds Ltd.
Kyoda Plastics Limited
Les Systèmes Thermoplast Inc.
Monarch Plastics Ltd.
Morbern Inc.
Norseman Plastics Ltd.
Pavaco Plastics Inc.
Persita Inc.
Plastiques Anchor Ltée
Plasti-Drain Ltée
Plasti-Fab Ltd.
Plax Inc.
Polytainers Inc.
Propak Plastics Ltd.
Pro-Western Plastics Ltd.
Rubbermaid Canada Inc.
Scepter Manufacturing Co. Ltd.
Shaw Industries Ltd.
Schlegel Canada Inc.
Spartan Plastics Canada Inc.
Systèmes Thermoplast Ltée
Transco Plastic Industries Ltd.
Union Carbide Performance Plastics Ltd.
Uniplast Industries Ltd.
Vanguard Plastics Ltd.

Pulp and Paper

Abitibi-Price Inc.
Armstrong World Industries Inc.
Atlantic Packaging Products Ltd.
Beaver Wood Fibre Co. Ltd.
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company Limited
Canadian Forest Products Ltd.
Canadian Pacific Forest Products Limited
Cariboo Pulp & Paper Company
Cascades (Cabano) Inc.
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Celgar Pulp Company
Consolidated-Bathurst Inc.
Corner Brook Pulp & Paper Ltd.
Crestbrook Forest Industries Ltd.
Daishowa Inc.
Domtar Inc.
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp & Paper Co. Ltd.
F.F. Soucy, Inc.
Fletcher Challenge Canada Limited
J. Ford & Company Ltd.
Fraser Inc.
Gaspesia Pulp & Paper Company Ltd.
Howe Sound Pulp and Paper Limited
Irving Pulp & Paper, Limited
Irving Tissue Co.
Island Paper Mills Company
James River - Marathon, Ltd.
Kimberly-Clark of Canada Limited
Kruger Inc.
James Maclaren Industries Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power Inc.
Manfor Limited
Minas Basin Pulp and Power Company Limited
Miramichi Pulp and Paper Inc.
NBIP Forest Products Inc.

Northwood Pulp and Timber Limited
Paperboard Industries Corporation
Perkins Papers Ltd.
Procter & Gamble Inc.
Quebec and Ontario Paper Company Ltd.
Rolland Inc.
Rothesay Paper Limited
St. Anne-Nackawic Pulp & Paper Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Limited
Scott Paper Limited
Skeena Cellulose Inc.
Sonoco Limited
Spruce Falls Power and Paper Company, Limited
Stora Forest Industries Limited
Strathcona Paper Company
Tembec Inc.
Weldwood of Canada Limited
Western Pulp Limited Partnership
Weyerhaeuser Canada Ltd.

Canadian Textiles Institute

Albany International Canada Inc.
Artex Woollens Limited
Asten-Hill Inc.
Badishe Canada Ltd.
Barrymore Carpet Inc.
Bell Tootal Inc.
Bermatex Inc.
Britex Ltd.
Burlington Canada Inc.
Celanese Canada Inc.
Cleyn & Tinker Inc.
C&T Modele Inc.
Coats, J.& P., (Canada) Inc.
Consoltex Inc.
Fashion Division –
- Cowansville
- Drummondville

Home Furnishings Division –
- Sherbrooke

Outerwear Division –
- Alexandria
- Montmagny
- Coaticook

Crossley Karastan Carpet Mills Ltd.
DeBall, J.L., Canada Limited
Dominion Textile Inc.
Apparel Fabrics –
- Beauharnois Finishing Plant
- Domil, Sherbrooke
- Drummondville
- Long Sault, Fabrics
- Magog

Consumer Products –
- Caldwell, Iroquois
- Sherbrooke
- Esmond, Granby
- Magog

Sales Yarn –
- Domil, Sherbrooke
- Long Sault, Yarns
- Mount Royal Dye House, Montreal

Industrial Products –
- Drummondville
- Yarmouth
- Hawkesbury
- Woodstock

Drytex, Division of JWI Ltd.
Dura Undercushions Ltd.
Les Tricots Duval & Raymond Ltée
Harding Carpets Limited
Harvey Woods Limited
Heuga Canada Limited
H.N. Biron & Fils Inc.
Huyck Canada Limited
Leedye Inc.
Newlands Textiles Inc.
Nova Scotia Textiles Ltd.
Ozite Canada (1981) Inc.
Patons & Baldwins Canada Inc.
Peeters Carpets Ltd.
Rayonese Textile Inc.
Rubyco Inc.
Rumpel Felt Company Limited
Satexil Inc. Division Texgran
Tapis Coronet Inc.
Tapis Peerless Ltée
Tapis Venture Canada Ltée
Textiles Dionne Inc.
- St. Georges de Beauce Division
- Montmagny Division
- Drummondville Division

Tricots Canada U.S. Inc.
Waterville Cellular Products Ltd.

Transportation (Mfg.)

Aerospace Industries Association of Canada

Aircraft Appliances and Equipment Limited
Airtech Canada
Bendix Avelex Inc.
Boeing Canada – de Havilland Division
Bombardier Inc.
Canadair Aeronautical & Defense Group
CAE Electronics Ltd.
Canadian Marconi Company
Chicopee Manufacturing Limited
Computing Devices Company
Conair Aviation Ltd.
Dew Engineering and Development Limited
Field Aviation East Ltd.
Garrett Canada
Haley Industries Ltd.
Heli-Fab Ltd.
Howland Russell Consultants Ltd.
Indal Technologies Inc.
Litton Systems Canada Limited
Lucas Industries Canada Limited
McDonnell Douglas Canada Limited
Pratt & Whitney Canada Inc.
Raytheon Canada Limited
Rockwell International of Canada Ltd.
Rolls-Royce (Canada) Limitée
Spar Aerospace Limited
UDT Industries Inc.
Unisys Canada Inc.
Walbar Canada Inc.

Automotive Parts Manufacturers' Association

Accurcast
Algoods, Division of Aluminum Company of Canada Ltd.
Allied-Signal Automotive of Canada Inc. – Fram Canada Division
Amcan Castings Limited
Associated Spring – The Wallace Barnes Company Ltd.
B & W Heat Treating (1975) Limited
A. Berger Precision Ltd.
Blackstone Industrial Products Limited
Budd Canada Inc.
Canada Forgings Inc., A Division of Toromont Industries Ltd.
Champion Spark Plug Company of Canada Inc.
Collins & Aikman Inc.
Court Industries Co. Ltd.
Daymond, a Division of Redpath Industries Limited
Degussa Canada Ltd.
Dominion Controls Company
Epton Industries Inc.
Excel Metalcraft Ltd.
FAG Bearings Ltd.
Ferraloy, Pullman Canada Ltd.
Gabriel of Canada Ltd.
Galtaco Inc.
Goodyear Canada Inc.
Hayes-Dana Inc.

Hoover Universal (Canada) Ltd.
Hull-Thomson Limited
Jet Moulding Compounds Limited
Kelsey-Hayes Canada Limited
Lagran Canada Inc.
  (Burlington Canada Inc.)
Lear Siegler Seating Corp.
Mastico Industries Limited
MTD Products Ltd.
The Narmco Group
PPG Canada Inc., Duplate Division
Pebra Inc.
Precision Rubber Products (Canada) Ltd., a Wynn's International Subsidiary
Reynolds Aluminum Company of Canada Ltd.
Rockwell International Suspension Systems Company
Sheller-Globe
Siemens Bendix Automotive Electronics Limited
Sinteris Inc.
Slater Steel Corporation
Standard Tube Canada Inc.
Stemco Canada
Techform Products Limited
Thomson (Canada) Rivet Co. Limited
Tridon North America
Trim Trends Canada Limited
Velcro Canada Inc.
Webster Manufacturing (London) Limited
Westhead Industries

Canadian Maritime Industries Association (Formerly Canadian Shipbuilding and Ship Repairing Association)

Allied Shipbuilders Ltd.
Diamond Canapower
Marine Industrie Limitée
Marystown Shipyard Ltd.
MIL Davie Inc.
Pictou Industries Limited
Port Arthur Shipbuilding
SaySar Inc.
Securiplex Systems Inc.

Canadian Truck and Trailer Manufacturers' Association

Cusco Ltd.
The Trailmobile Group of Companies Ltd.

Allied Boating Association of Canada

Lund-Larson Boats Canada Ltd.

Motor Vehicle Manufacturers' Association

Chrysler Canada Ltd.
Ford Motor Company of Canada Ltd.
General Motors of Canada Ltd.
Navistar International Corporation Canada
Volvo Canada Ltd.

Wood Products (Western)

Balfour Forest Products Inc.
Canadian Forest Products Limited
Evans Products Co. Ltd.
Federated Co-Operatives Ltd.
Finlay Forest Industries Ltd.
Fletcher Challenge Canada Limited
Gormon Bros. Lumber Ltd.
Groot Lumber Ltd.
International Forest Products
MacMillan Bloedel Ltd.
Nechako Lumber Co. Ltd.
Northwood Pulp & Timber Ltd.
The Pas Lumber Company Ltd.
Quesnel Forest Products
Riverside Forest Products Ltd.
Rustad Bros. & Co. Ltd.
Stuart Lake Lumber Co. Ltd.
Weldwood of Canada Limited
West Fraser Mills Ltd.
Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces followed a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year consumption to the energy that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Similarly, energy cost savings is the difference between what would have been spent on energy (if there had been no efficiency improvement) and the current energy expense. The figure fluctuates because of the voluntary nature of participation in the program; estimates of energy savings depend on the quantity of energy reported by the CIPEC participating companies and total efficiency improvement in that particular year.

Feedstocks used in the chemical and petroleum refining industries are not included in the task force or CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the ferrous metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and periodic changes in raw material quality. These corrections are done at the individual company level which often report both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

After more than a decade of CIPEC monitoring most task forces updated individual reference years to 1985 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forth the past achievements, however, to retain the long term trends in performance.

Appendix B

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	0.003.6 MJ/kWh	3413 BTU/kWh
– gross	0.010551 MJ/kWh	10000 BTU/kWh
Natural Gas	0.0372 MJ/m^3	1.0×10^6 BTU/MCF
Propane	0.0266 MJ/litre	0.1145×10^6 BTU/IG
Crude Oil (#6)	0.0385 MJ/litre	5.8×10^6 BTU/bbl
Distillate Oil(#2)	0.039 MJ/litre	0.168×10^6 BTU/IG
Residual Oil (#5)	0.0423 MJ/litre	0.182×10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	0.0362 MJ/litre	0.156×10^6 BTU/IG
Diesel Fuel	0.0399 MJ/litre	0.172×10^6 BTU/IG
Kerosene	0.0388 MJ/litre	0.167×10^6 BTU/IG
Liquid Propane Gas (LPG)	0.0271 MJ/litre	0.117×10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

Photo – Foundry Operation
Volkswagen of Canada Ltd.

Appendix B

Errata

Subsequent to publication of this report, it was discovered that an error had been made on the conversion tables. Please substitute the table below for the tables listed on page 83.

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	0.0036 GJ/kWh	3414 BTU/kWh
– gross	0.010551 GJ/kWh	10000 BTU/kWh
Natural Gas	0.0372 GJ/m^3	1.0×10^6 BTU/MCF
Propane	0.0266 GJ/litre	0.1145×10^6 BTU/IG
Crude Oil (#6)	0.0385 GJ/litre	5.8×10^6 BTU/bbl
Distillate Oil(#2)	0.039 GJ/litre	0.168×10^6 BTU/IG
Residual Oil (#5)	0.0423 GJ/litre	0.182×10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6×10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0×10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0×10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0×10^6 BTU/ton
Gasoline	0.0362 GJ/litre	0.156×10^6 BTU/IG
Diesel Fuel	0.0399 GJ/litre	0.172×10^6 BTU/IG
Kerosene	0.0388 GJ/litre	0.167×10^6 BTU/IG
Liquid Propane Gas (LPG)	0.0271 GJ/litre	0.117×10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

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